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Methods of Making Casing and Casing Couplings—I

P. H. BRYANT

Despite efforts at standardization, a large variety of methods and tools is still employed in the manufacture of oil-well casing and couplings. The author has made a study of these methods dating back ten years. In the following articles he summarizes the results of his findings which are of interest because of the revival in the petroleum industry

IT IS NOT generally known either to machine tool builders or tool accessory manufacturers that, during the last years of industrial activity before the paralysis, one special branch of the steel industry was in process of undergoing revolutionary changes in manufacturing policy and methods which, when carried to completion, will establish that particular department on a par with the best present practice in precision production.

The department referred to is that for processing oil-well casing and casing couplings, a product that up to within a decade, was made from low crade stock by various welding processes, but which now must be seamless and of a material specification that makes machining difficult.

This basic change in specification was far reaching in its effects. Prior to that change, few of the steel mills had found it profitable to do more than thread the pipe ends, preferring to purchase the machined couplings from outside sources of supply. For a nominal investment, these outside sources had been able not only to compete successfully with the mills on machine work but in producing the raw material or coupling blanks.

With the advent of the seamless specification and the installation in all the steel plants of seamless tube mills of the large size capacity required for casing, the logical source of supply for couplings—cut lengths of seamless tubing—was brought into the confines of the mills, and outside manufacturers were faced with the necessity of developing a new source of supply that would put them on a basis to compete or of going out of the business.

The status, therefore, when production in all quarters dropped off, was that the outside producers had the equipment for machining, but no means of securing raw materials, while the mills had the raw materials but little equipment capable of continuous production to the close limits of accuracy required. Even that available had not been designed to take care of the tremendous increase in the volume of stock to be removed, one result of the change from welded to seamless blanks.

Here then are two prospective markets that await new developments to meet their needs.

A practical method for providing seamless blanks that conform closely to the contour of the finished product would enable the outside manufacturer to compete again and make it possible to put his idle equipment back to work when this market, along with others, picks up. The specified requirement, that such blanks conform closely to the shape of the finished coupling, is one that is absolutely essential.

Welded couplings were "sized" after welding by various processes, which reduced the amount of stock to be removed to not more than 15 to 20 per cent of the weight of the finished coupling. The machining methods of the older producers are based on this percentage. Cut seamless blanks average from 60 to 100 per cent heavier than the machined product, and this excessive amount of material to be removed not only complicates the processing but raises the unit price per pound to a figure that would leave no margin for machining profit.

If, however, the outside producer could purchase, or manufacture for himself, a blank reduced 30 per cent in weight from the cut tubing the mill must use and had correspondingly less stock to remove in machining, he would be back in competition with the mills immediately. The mills, on the other hand, have their cut lengths of tubing and face the problem of machining it economically and accurately.

The machinery trade should understand at the outset that this is not a market that lends itself to adaptation of standard tools to these special purposes—not readily at any rate.

The engineering and production personnel in the mills have gone just far enough into an analysis of what they must do to meet the present American Petroleum Institute gage requirements, starting with heavy-walled seamless blanks, to be in a mood to commit mayhem on any tool salesman that would suggest buying a machine from stock and tooling it to meet their requirements.

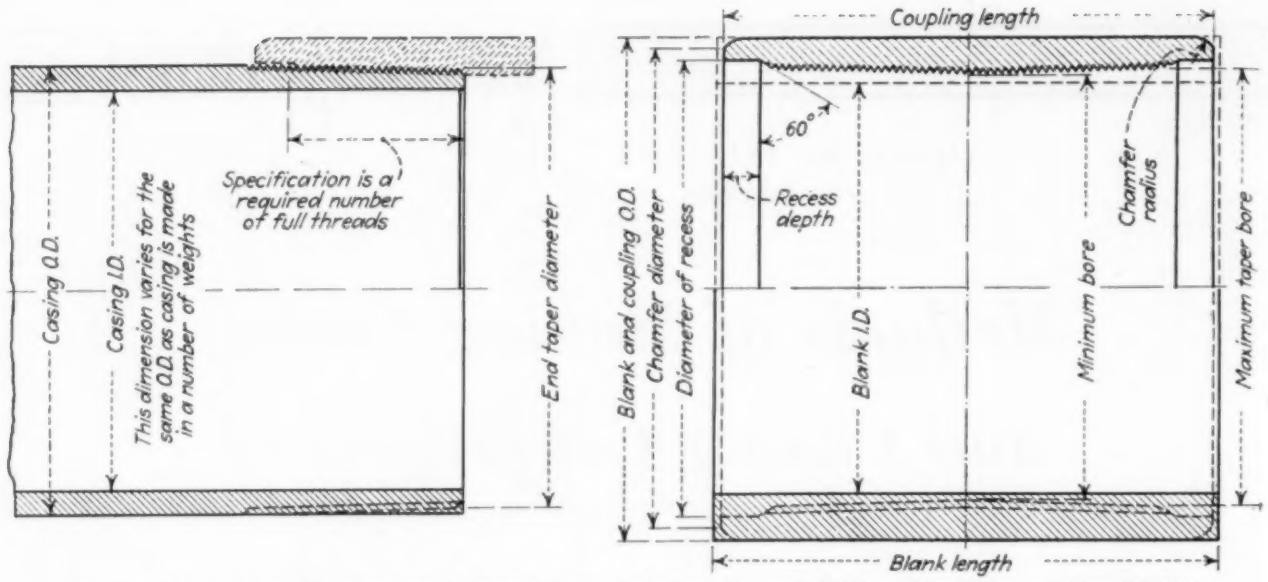

Fig. 1—General specifications are indicated for a typical casing end (left) and a casing coupling (right)

An approach to this market would be suicidal of any subsequent opportunity for consideration, if not based on at least a general idea of the problems it involves and a proposal that, in fully developed detail, offered a practical solution to one or more of those problems.

It is obvious that for the machine tool dealer or special tool designer to proceed along such lines he must acquire a background of special knowledge which no current engineering data can supply and which the mills themselves are not disposed to spread abroad. While only a fragmentary idea can be given within the limitations of this article, I believe the insight into the present state of the art given herein, will serve as a starting point for that essential background.

Threading Ends of the Casing

No change has yet been made in the long established practice of die-cutting threads on the casing ends with some standard type of pipe threading machine.

Since the stock became seamless however, the number of threads cut that will not pass inspection has increased to a point beyond all reason. The practice is to trim off a rejected thread and recut the end; the production engineer in one of the largest plants stated to the writer in the fall of 1929 that daily reports of number of threads cut and lengths of casing threaded, disclosed that an average of three cuts was being made to get one good thread. Cutting from the rough, as this process does, there is too much stock above the thread line which the die chasers must remove.

The trend is in one of two directions:

1. A process that will first taper turn and chamfer the casing end, leaving only the thread contour for the die to cut.

2. A thread-milling process preferably with the casing stationary and the milling head and its mounting means revolving radially about the work.

Any development for this purpose must make certain that the axis of the thread cone generated coincides within the closest possible limits to the axis of the casing, as the field requirement of this material makes bends at the joints objectionable.

Production of Seamless Couplings

A. From lengths of tubing (Fig. 2a).

In the smaller sizes these blanks are cut to length and usually partially machined on some standard make of multiple-spindle automatic. In sizes above four inches, however, single lengths of tubing are cut in most cases by a standard cutting-off machine, revolving the work and provided with a front and rear cut-off slide with tools tracking in a single cut.

A special slide with two sets of tool carriages, permitting of setting the tools varying longitudinal distances apart, has been used successfully, producing two cut blanks to each chucking operation. Attempts have been made to develop a means for making the cuts with a milling saw traveling one turn around the stationary tube, but such a process has not, to the writer's knowledge, been put in production.

Also one producer experimented with cutting the lengths with a cold saw, with unsatisfactory results, possibly because his machining process fed a broad facing tool longitudinally against the coupling end in finishing to length, and the tools would not stand up against the glazed surface of the cold cut.

Some manufacturers cut the couplings to finished length, at the same time form-tooling the outside chamfer. If this is done, a slight amount of stock must still be left for a finishing cut on the faces, as trouble will be caused in the field if the plane of the finished face is not at right angles to the axis of the generated thread.

B. Hot-drawn and trimmed blanks (Fig. 2b).

For years the largest source of supply of couplings for purchase has been blanks hot drawn from plate stock, in the form of thimbles with the solid bottoms punched out or trimmed off. This method has been under fire for a long period, because two sections of the coupling have a longitudinal grain while two intervening sections have a cross grain. The process has not been condemned by the A.P.I., however, but should not be selected as a basis for new developments.

C. Hot-forged blanks (Fig. 2c).

While both practical and economical for small couplings, as the blank diameter and length increase, this process rapidly passes out of the range of practicability. The bar stock, which is first expanded to the blank O.D. and length, and then punched out, becomes a heating and handling problem presenting great difficulties in itself. On top of that the tendency of the punch, on the final step, to drag stock along with it and deeply score the interior surface makes it necessary to leave an excessive amount of finish in the bore.

Far short of those standard sizes of A.P.I. couplings that run to volume production, the forging method becomes too

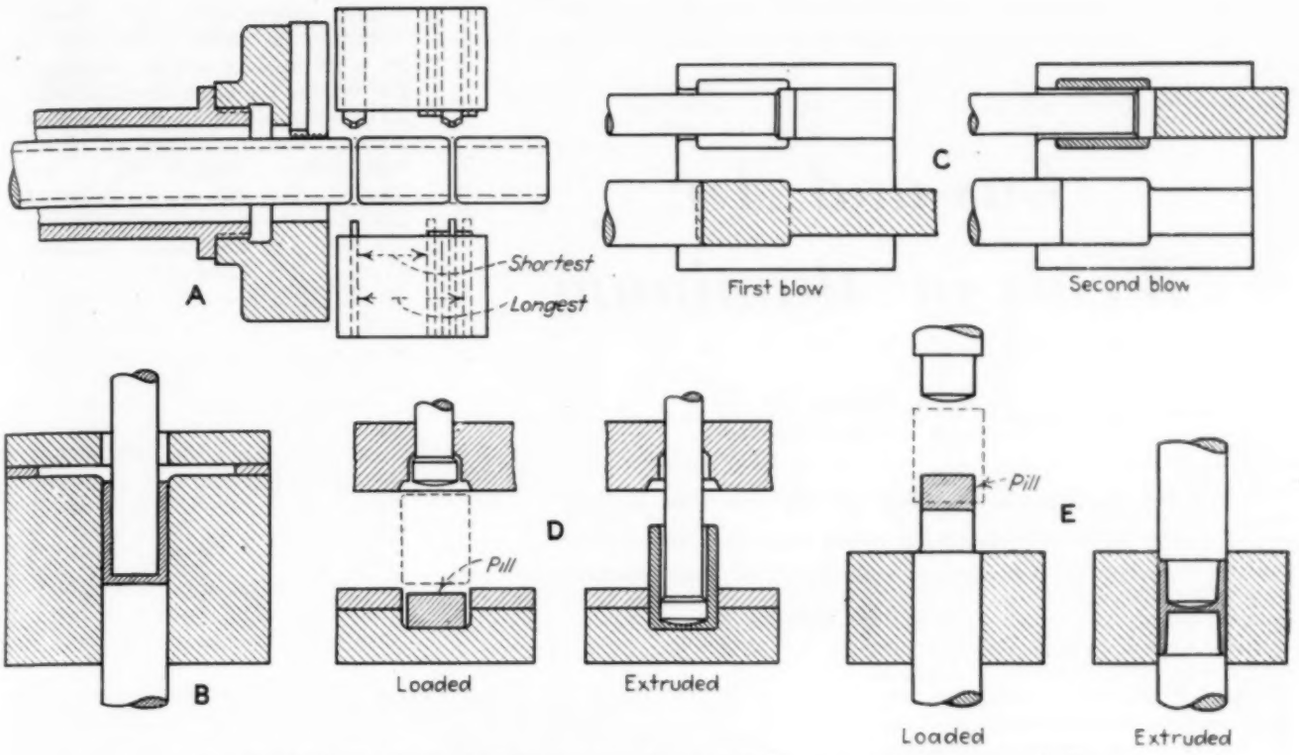

Fig. 2—Various means of producing seamless couplings are shown diagrammatically

cumbersome to be practical. Hence it is not a logical basis for development; its use would require the further development of a second method to produce blanks beyond its capacity range.

D. The single-end extrusion method (Fig. 2d).

When one of the largest producers of couplings only, who had used a welding process of its own for several years, was faced with the problem of providing seamless blanks, he spent several hundreds of thousands of dollars in the development of specially designed presses and die equipment for producing blanks by extrusion.

The results up to a certain point had been so disappointing and the development so costly that it was abandoned before its full possibilities had been determined. Partly for that reason and partly because industrial development is spotted with examples of today's failure becoming tomorrow's success, the major features of the method and the difficulties that were uncovered by experience are outlined here.

By reference to the sketch, it will be seen that the press tooling consisted of a mushroom headed punch, centered in a ring die of such diameter that an annular space was left between the die and punch, corresponding to the desired cross-section of the cylindrical blank. In operation, a cut length from a round bar —its length being not over two-thirds of its diameter and its weight ten per cent in excess of the weight of the finished blanks—was brought to a white heat, centered in the hollow of the die, and at the stroke of the plunger was squashed up through the annular space in the form of an elongated cylinder.

In theory it looks simple, but its development brought to light difficulties that were formidable. The most important of these were as follows:

1. Controlling the flow of extruded metal from the hot "pill" so that it spread evenly in all directions from the central source, was found to be a hard nut to crack. Gradually the excess of weight in the pills, over the weight of the formed blanks, was increased to make up for one side of the cylinder being long and the opposite side foreshortened.

2. Equalizing the resistance to flow to an extent that the extruded form would not be curved like a section of an auto tire.

3. To find a material for the ring die that would not abrade quickly and rough up the outer surface of the couplings.

4. To design a press that would stand the varying stresses to which variations in heating and handling gave rise.

For the initial experiments, a 200-ton crank press was used to extrude 5-in. O.D. blanks. If the pills were at anything less than "puddling" heat and any delay occurred in the transfer from furnace to die, it was not uncommon to have this press stall, a fact which should give an idea of the enormous strains set up.

E. The double-end extrusion method (Fig. 2e).

The falling demand for coupling blanks in the years 1928-29 caused the abandonment, for the time being at least, of a development in double-end extrusion that has many features of interest and great potential possibilities.

The method produces a blank that closely corresponds in longitudinal section to the finished coupling, leaving little stock to be removed in machining. If this method could be developed practically so that the tapered punches were held in alignment, and the pair centered axially within the inclosing ring, it would establish keen competition for cut tubing.

Up to the point to which this development was carried, it presented only one serious difficulty—to find a type of press adapted to its requirements and heavy enough for the work. For all development work done, crank presses were used, but I believe that only presses having punches actuated by fluid pressure, will survive this service. The degree of "chill" of the thinning wall of metal between the two pinches as they close in, is bound to vary over a wide range, and the thickness of that wall when it becomes incompressible will vary accordingly. With hydraulic operation, variations in the thickness of this wall does not vary the stresses, while an extra thick, chilled flash will overstrain a crank-press beyond the limits of safety.

Gas and Arc Welds in Aluminum

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Information is provided on the processes as they are applied today with some data that may prove useful in estimating welding costs for practical shop operations

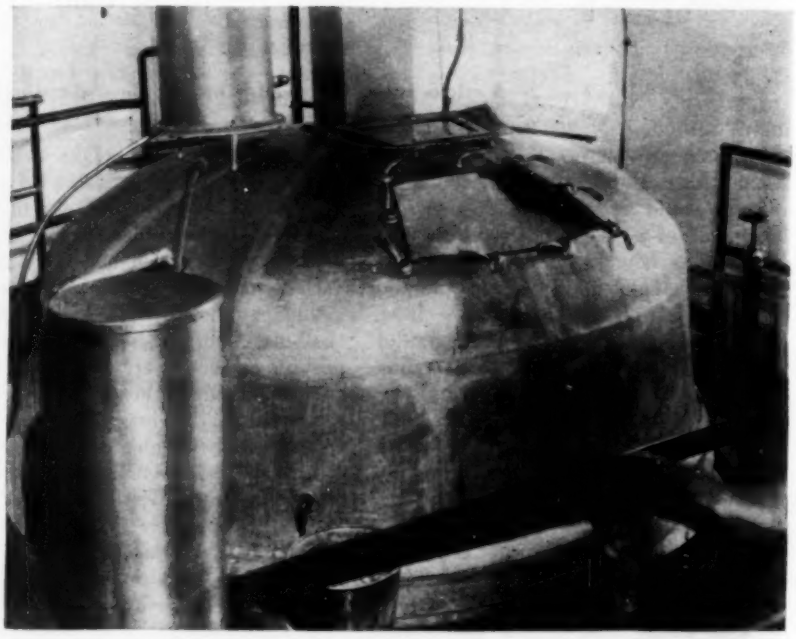
FOR TWENTY or more years, the welding of the aluminum alloys with the gas torch has provided a useful tool for joining these materials, both in this country and abroad. The past decade has broadened the fields of application of these alloys tremendously with consequent development and progress in the process of fusion welding.

The production of aluminum torch welded parts is done commercially with either the oxy-hydrogen, oxy-acetylene or oxy-natural gas flame. From the standpoint of strength or soundness of the welds, there is little to choose between the three gases. From the standpoint of cost, local conditions in the plant determine the correct choice. However, on the heavier gages, 0.250 in. and above, oxy-acetylene is almost universally applied, as the higher flame temperature and the flame speed permit faster welding. On light gage material, 0.050 in. and under, particularly the cooking utensil field, oxy-hydrogen and oxy-natural gas find extensive applications. The advantage of using the latter two gases is particularly apparent when these gages are welded by persons inexperienced on welding aluminum.

All of the aluminum alloys are covered with a protective oxide coating. This coating is beneficial and contributes to the excellent resistance of these alloys to corrosive attack, but it must be removed when welding as it will prevent the ready flow of the molten metal under the flame into a sound weld. This is done most readily with a flux that will break up and flow the coating away from the weld. There are a number of suitable fluxes on the market. The actual fluxing operations are usually handled by mixing the powdered commercial forms of this material with water to the consistency of a watery paste, in a glass or an aluminum receptacle. The mixture is then painted on the joint or applied to the welding rod by dipping. For localities where the tap water carries more than the average quantities of impurities, the use of distilled water for mixing the flux is recommended.

For joints requiring the application of a filler rod, two compositions are used for practically all applications. For welding commercially pure aluminum (2S) and for welding aluminum alloy 3S, a 2S welding rod is recommended. For welding the other alloys, practically all of which contain larger quantities of alloying constituents, the use of a silicon-aluminum welding rod is recommended. This rod, commonly known as 43S alloy, has a comparatively low melting point and contributes considerably to eliminating cracks in the welds or the parent metal near the weld when the parts cool. This is particularly true when welding the heat-treatable alloys in jigs and fixtures where there may be a tendency to prevent the uniform contraction of the parts after welding.

The conventional methods of preparing sheet or plate are used when welding the aluminum alloys. Butt welds in sheet or shapes up to 14 B & S gage (0.064 in.) can be welded with no preliminary preparation in the way of V-ing or notching. The buckling of light gage parts containing large flat areas with welded joints is frequently minimized by running a ¼-in. radius bead about 1 in. on each side of and parallel to the weld. On material from 0.064 in. to ⅛ in. thick, good penetration and increased welding speed are obtained by notching the joint with a cold chisel. The notches are cut about ⅛ in. deep and spaced approximately ⅛ in. apart along both abutting edges of the sheet. It is an almost universal practice to V joints where the gage is heavier than ⅛ in. This is generally done by a machining or a pneumatic chisel operation. A V with an included angle of from 70 to 90 deg. is cut leaving a lip about



This 100-barrel steam-jacketed aluminum brew kettle was torch welded with oxy-acetylene gas by the Brown Sheet Iron & Steel Company

From a paper presented before the American Welding Society, in New York City, on November 22.

$\frac{1}{8}$ in. wide on the lower side. Sheet $\frac{1}{2}$ in. or over is V-ed and welded from both sides.

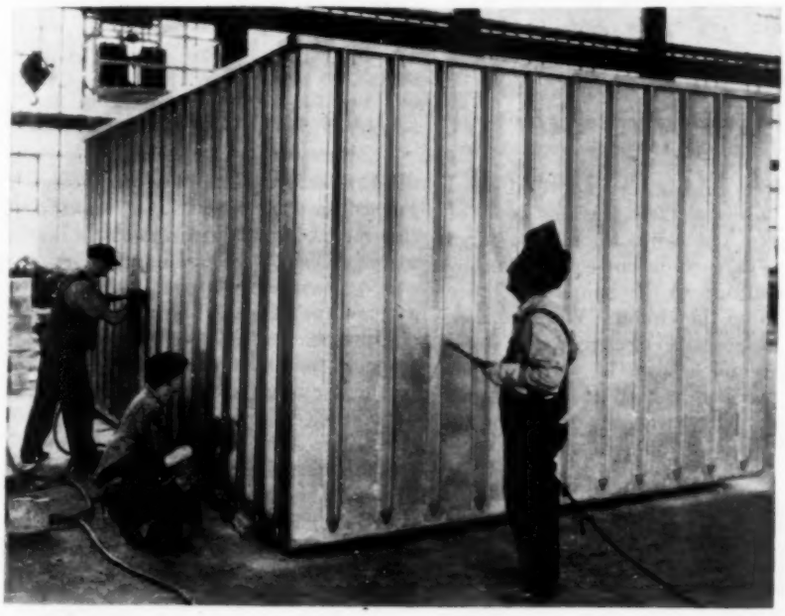
Estimating the cost of aluminum welding jobs is of interest in view of the greater frequency with which these jobs are occurring. Table I contains a résumé of data collected in a plant doing general jobbing work, and represents actual production conditions rather than results from laboratory tests. Under ideal conditions there is no question but that the rates given can be increased considerably.

The data in Table I are given in the form of the amount of welding one man can do per hour in order to make the data applicable generally. Rates for welders differ in different localities and it should be comparatively easy to estimate the cost of a welding job, once it is determined how long it will take to do the job. The data is entirely for gas welding.

Some additional factors affecting the cost of welding are itemized below:

Table I—Data on Torch-Welding Aluminum Sheet

Gage in.	Preparation of joint	No. of times weld gone over	Gas used	Tip size no.	Number men	Wire dia. in.	For 100 ft. weld: wire lb.	For 100 ft. weld: flux lb.	Rate of welding ft. per hr.
$\frac{1}{16}$	None	Once	Oxy-hyd.	4	1	0.125	3.0	2	14.0
$\frac{1}{8}$	Notched	Once	" "	4	1	0.146	6.5	2	12.0
$\frac{1}{4}$	V one side and notched	Twice	Oxy-acety.	5	1	0.184	20.0	4	10.0
$\frac{3}{8}$	V one side and notched	Twice	" "	7	1	0.184	30.0	4	7.0
$\frac{1}{2}$	V both sides and notched	Twice outside once inside	" "	8	Welder and helper	0.250	35.0	5	4.0
$\frac{5}{8}$	V both sides and notched	Twice outside once inside	" "	8	Welder and helper	0.312	40.0	5	3.5



To this aluminum beer tank, the sidewall stiffeners were metallic arc welded

1. Gas used

When welding with the oxy-hydrogen flame, an experienced welder will usually use about two bottles of oxygen and five bottles of hydrogen in an eight-hour day. In welding with oxy-acetylene, he will use about one bottle of acetylene to two bottles of oxygen in an eight-hour day. Both of these statements assume that the welder works consistently for the entire day, with no time out for the preparing of joints, setting up the work in jigs, or similar work.

2. Experience

The amount of welding turned out is dependent to a certain extent on the individual doing the work. The figures given assume that the man not only is experienced in welding aluminum but also experienced in the particular type of work which is being considered; that is, an average welder will produce the number of feet of seam tabulated, after he has had an opportunity to become familiar with the type of work being done. For the first application of welding attempted by any company, an extra allowance of 25 per cent of welding costs would not be excessive, even though the welder has some experience in welding aluminum. For organizations where no welding of aluminum has been done, this should be increased, depending on the complication of the job in question.

3. Preparation of joints and tacking

Table I does not consider the time necessary to V and notch the joints and to tack the weld before the final welding. Shop practice varies a great deal in doing this work and it is not practical to give any figures which might be generally applicable. The tacking operations ordinarily are done at about three times the rate of straight welding along the seams, but a great deal depends on the time necessary to line up the work and get the parts placed right, which are a function of the particular job at hand. This does not lend itself to figures which can be generally applied.

4. Miter joints

It is not possible to give definite figures for miter joints, as the time of welding is generally not a function of the number of feet to be welded, but is dependent on the complication of the section being welded. The general statement can be made, however, that the joint can be welded in equal or less time than is required for welding a comparable joint in steel and also in slightly less time than the joint would require if brass or bronze were used.

5. General construction welding

Here again figures in the table should not be applied literally as it will generally require substantially more time than is shown above. The actual rate of welding on aluminum as compared with steel, however, is somewhat faster, and a reasonable estimate can usually be arrived at if the time necessary to weld the joint on steel parts is taken as a basis. This can be done in most cases because of the more comprehensive data on welding steel which are available to most concerns.

An item which is frequently neglected, in computing costs when welding aluminum, is cleaning the joints after welding; consequently the cleaning operations are sometimes omitted. The flux must be removed after the joint is welded to prevent corrosive attack. One of the best ways known of doing this is immersing the parts for one hour in a ten per cent sulphuric acid solution and washing the acid off the parts with running water. This item should be given con-

sideration on every welding job, and if thoroughly understood will anticipate and prevent field troubles. On very large parts, an immersion in acid may not be practicable. In this case a thorough washing with a brush and hot water or steam jet will clean the joint.

A joint that is cleaned can be tested for the presence of flux by dropping on it a few drops of a two per cent silver nitrate solution. If the joint is clean, there will be no precipitate formed and the solution will remain colorless.

Arc Welding

The use of the electric arc for welding the aluminum alloys is one of the rapidly expanding means of joining these materials. For manual welding, the metallic arc method has been proved successful by a considerable number of commercial applications. For automatic welding, the carbon arc offers promise and steps are now being taken to place a production unit in operation. At the present time, however, the metallic arc is established in the field and the following remarks apply to it only.

Metallic arc welds in aluminum have the advantage that the area near the welds affected by the welding heat is considerably narrower than is encountered when using the gas torch. This is particularly apparent when welding the heat-treatable alloys. In addition, the tendency of these alloys to show heat cracks, (caused by hot shortness when torch welding), is minimized or entirely eliminated. The operation is faster than torch welding. The cost of metallic arc welding operations is approximately the same as the cost of torch welding operations, though a saving is generally shown on gages between ⅛ in. and ¼ in. as no preliminary V-ing or notching is necessary.

No special equipment is necessary to apply arc welding to aluminum, the standard motor generator sets found in most plants being satisfactory. On light gages (0.064 to 0.125 in.), it may be desirable on some equipment to include a resistance of ¼ to ½ ohm in series with the arc, to provide arc stability. A.c. welding equipment, particularly the type with a super-imposed high-frequency current on the welding circuit, has also been used with excellent results.

A flux coated rod is required for metallic arc welding. There are a number of suitable coated rods available. The flux coating serves the same purpose as in torch welding in removing the oxide surface film that would prevent the formation of a sound weld and, in addition, stabilizes the arc. Considerable testing and experience has shown that the most useful rod composition is an alloy of aluminum and silicon, and all of the standard rod is of this composition. For special cases, it is frequently possible to prepare specially dipped rods with a rod composition the same as the parent metal.

The technique for metallic arc welding aluminum is comparatively simple and readily learned. The rod is mounted in the holder and the arc established by brushing against the work. A comparatively long arc is held until the edges start to melt and then shortened as much as possible. The motion along the seam on butt joints should be a straight forward or backward motion, the rod held vertically, with no weaving. Recommended rod diameters and current settings for the first trial for any job are shown in Table II. It is generally safe to choose a rod diameter the same as, or close to, the gage of metal being welded.

The arc welding of material below 14 B & S gage (0.064 in.) is somewhat difficult and is not generally attempted in production. From this gage up to ¼ in., however, butt welds are made with no preliminary V-ing or notching. Backup plates of steel or copper are generally applied under the joint to insure adequate and uniform penetration. Material heavier than ¼ in. is V-ed with a 70 deg. to 90 deg. V, leaving a $\frac{3}{16}$-in. or ⅛-in. lip at the apex.

The previous remarks made on removing torch-welding flux apply as well to arc welds. The flux on the joint after welding must be removed to prevent the possibility of corrosion troubles in service.

Table II—Electrode Size and Machine Setting for Metallic Arc-Welding Aluminum

Thickness (inch)	Electrode diameter (inch)	Amperes
0.064	$\frac{1}{16}$	45-55
0.081	$\frac{1}{16}$	55-65
0.102	$\frac{1}{16}$	65-75
0.125	$\frac{1}{16}$	75-85
$\frac{5}{64}$	⅛ or $\frac{5}{64}$	85-100
$\frac{3}{32}$	$\frac{5}{64}$	100-125
$\frac{1}{16}$	$\frac{3}{32}$	125-175
¼	$\frac{5}{32}$ or $\frac{3}{16}$	175-225
$\frac{5}{16}$	$\frac{3}{16}$	225-300
⅜	¼	

Keeping Electric Tools on the Job

Electric wiring is an important item in shops using electric portable tools of any kind. The wires should be large enough to carry sufficient current for the tool in addition to the lamps and other appliances on the circuit. Wappat, Inc., makers of portable electric tools, stress this point and advise the use of larger sizes of tension cables as their length increases. They suggest the following sizes for drills of different sizes:

	Size of Drill—Inches			
Length of Cable	¼	⅜	½	¾
50 ft.	No. 18	16	14	14
125 ft.	16	14	12	10
250 ft.	14	10	10	8

Small cables, or small wires in the shop circuit reduce the voltage available at the tool. This overloads the motor and causes it to overheat, sometimes burning it out.

Electric tools should not be run idle as they over-speed, which is hard on both the carbon brushes and on lubrication. Motor bearings should be lubricated at regular intervals as directed by the maker. Brushes should be carefully watched and replaced when worn to half length. When not over ⅜ in. long they should generally be replaced. The commutator should be round and smooth. Use a clean cloth or very fine sandpaper when the commutator is dirty. Never use emery cloth or paper.

It is suggested that the gear case of electric drills should be cleaned and refilled after each 500 hours of service. For continuous service at 8 hr. a day, this means every three months. In the average shop, a cleaning and greasing every four months would probably be ample—and in many cases a six months cleaning date would be all right. But a record should be kept so that the infrequent cleanings are not neglected.

Some electric tools are equipped with three wires, one of which is grounded in the tool. With this wire connected to a ground, the operator is protected from shock should any ground occur in the motor.

Overload, dirt and insufficient or improper lubrication are the three causes of trouble given by manufacturers of electric portable tools. The failure to keep a motor clean with an air jet is responsible for much of the overheating troubles. Universal motors, which operate on either a.c. or d.c. current are subject to higher operating temperature than plain motors. This increases the need for care in keeping the ventilating passages open. As they heat much more in summer than in winter, care should be taken to use a lubricant that will stand the summer working temperature.

Electric drills and other tools should be cleaned at fairly regular intervals. Gasoline or naphtha is used for cutting grease and oil. The motor should not be started until the vapor from the cleaning fluid used has entirely evaporated.

Sparking may indicate an open coil in the armature, that new brushes are needed or that the commutator needs truing.

A shock from current may mean a loose wire in contact with the housing or a short circuit due to dirt, which allows current to pass from the brush holders to the housing.

Electric drills and other tools should be used on circuits of proper voltage, a 10 per cent variation either way from that stamped on the nameplate being allowable. It is advisable to keep a finger on the switch trigger when using so that current can be shut off instantly if the drill stalls. Be sure the drill is free before starting again.

Saving Time in Setting Keyseating Cutters

Discussion

ROBERT S. ALEXANDER

In discussing my article under the title given above (*AM*—Vol. 77, page 465), J. T. Towlson (page 692) asks, "But why go to the expense of providing gages for all the shafts of various sizes that need to be keyseated?" I believe that my use of the word gage in describing short, discarded pieces of shafting led him to overestimate the expense involved, which, of course, merely consisted of the time spent in milling the flat and sinking the cutter in each piece. Mr. Towlson then describes a method that I have frequently used, but have found that it took more time than by using my "gages."

More Accurate Methods

But there are other methods. One is to place a square on the machine table with the edge of the blade resting against the side of the shaft to be keyseated, then to use a scale from the blade to the edge of the cutter and to move the table so that the correct amount is spaced off on each side of the cutter, thus finding the center of the shaft. Another and more accurate method is to bring the side of the shaft against the rotating cutter so that the cutter barely touches the shaft at center height. Having set the micrometer collar of the cross-feed screw to zero and lowered the knee so that the cutter will clear the top of the shaft, the cross-slide is moved a distance equal to one-half the shaft diameter minus one-half the width of the cutter.

The truth of the old saying, "There is a right way and a wrong way of doing anything—but there is also a best way" is often exemplified.

Blueprints from Pencil Tracings

J. C. P. BODE

With the advent of production machines for blueprinting, it has become more and more necessary to produce tracings that will print well, although the blueprint paper may be overexposed. When one tracing at a time can be fed through the machine, the speed can be adjusted to suit each tracing. But when a big batch goes through, with many an old timer in the lot, the newer tracings are apt to produce overexposed prints that cannot be read unless the lines are good and black. These new tracings go through too rapidly to get good prints from the older ones that require a lot of exposure.

Of course, ink tracings do not bring about this difficulty, but with the present trend of not making ink tracings, especially of the more or less special designs, the making of pencil tracings on cloth has become the vogue. While it would be easier to make black lines on paper, cloth is more suitable because of its greater toughness.

It will be found that the answer is not just to use a soft, black pencil, as a black pencil on cloth smudges and rubs off in short order. The secret is to make black lines that neither smudge nor rub off shortly after they have been made. Experience has shown that an H or an HB pencil is about right, but the trick is to bear down hard enough so that an impression is made in the cloth. A sharp pencil, twirled slightly as it is drawn over the cloth, then going back over the line and forward again and bearing down well will give good results. It may be necessary with some pencils to brush the crumbled lead off of the tracings frequently, especially shortly after sharpening. For the dividers, a soft pencil having a sharp chisel point is recommended. For writing and for figures, a No. 2 writing pencil is about right.

Tracings made in this way will produce good prints. The hand can be brushed over them without smudging the lines, and when turning them over the embossed lines can be felt. All this sounds like a lot of trouble and a slow process, but the little extra time required will be well compensated for by prints that are easily read, though perhaps overexposed. As far as the grade of pencil is concerned, the individual draftsman will have to do a little experimenting.

Discarded at Last

FRANK C. HUDSON

Here is a radial drill that is at last on its way to the cupola. It was resting temporarily in a junk yard in Newport News, Va., when I saw it and snapped it, under bad lighting conditions. At the right is the back-geared cone which drove the drill spindle through the splined rod and the bevel gears at the lower edge of the arm. The feed was taken from the vertical shaft that drove the spindle, by the small cone shown.

There was no date to show when this machine was built but on the nameplate was the name of the Universal Radial Drill Co., Cincinnati, Ohio, and in addition Pat. Dec. 14, 1868. This makes the machine tool industry in Cincinnati older than is generally supposed. Who has a record of this company?

This machine was built when most of the old timers of today were boys. It has served long, but how well? Have you anything like it in your shop?

Kinks in Air Brake Maintenance

WHILE only one of the many phases of railway shop work, air brake maintenance offers a wide opportunity for the ingenuity of an enterprising foreman. The air brake shop is required to handle a wide variety of parts and to machine them to a close degree of accuracy.

Present good practice is to grind pump cylinders both in the air and water ends. One shop engaged in this work has a Heald internal grinder for smaller work, such as valve cylinders, and a Micro grinder for the larger work. The Micro grinder is equipped with a turntable by which both ends of the pump may be accurately aligned with the spindle at one set-up of the work, and the center distance on cross-compound pumps may be set accurately by means of a cross traverse with the micrometer screw.

Refinishing water pump deck seats, a job that often gives trouble, is taken care of by a special cutter bar. This bar, shown in Fig. 1, is supported by bushings at both ends and extends entirely through the valve hole. It is fed by a handwheel, operating on a fine thread, which extends through the back end. The thrust is taken by a ball bearing. A face mill, driven by a portable air motor coupled to the tapered shank, does the cutting.

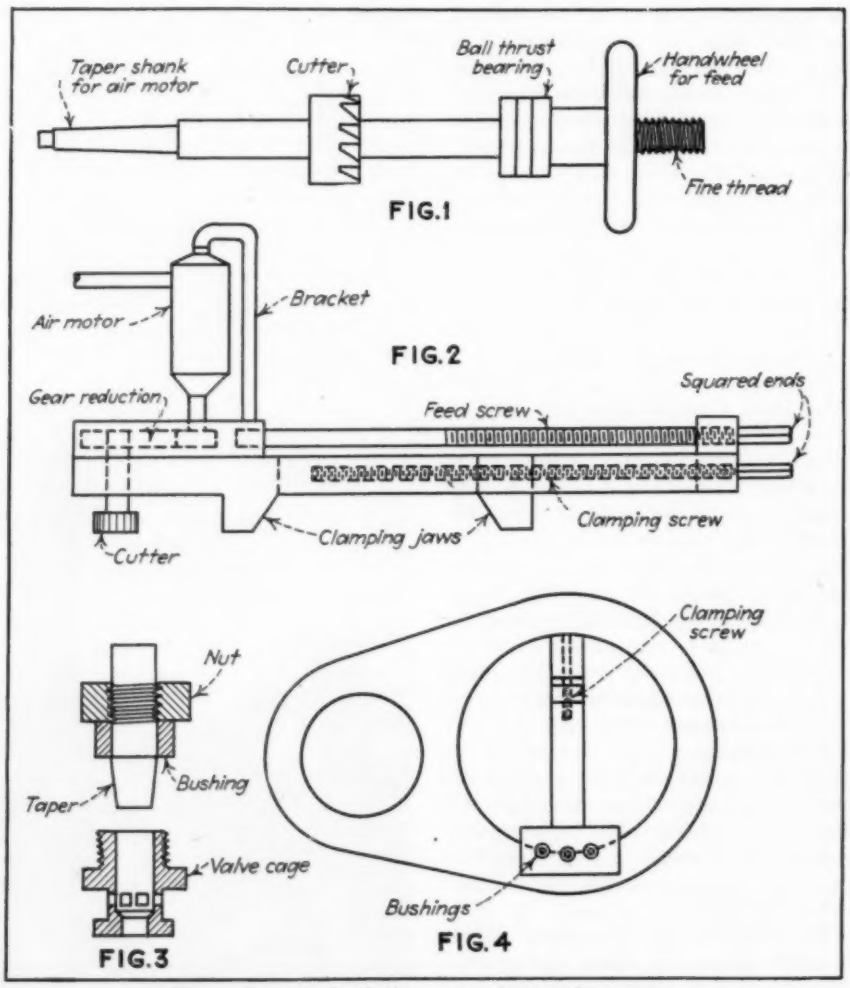
Another handy tool is used for cutting ports in cross-compound pump cylinders after they have been rebushed to compensate for wear. Before the bushing is pushed into place, the port centers are carefully marked with a punch mark on the face of the cylinder. Then the tool illustrated in Fig. 2 is clamped inside the bore, using the screw provided to expand the jaws. Another screw provides the means whereby the milling cutter is fed by hand. An air motor, acting through a single gear reduction, drives the cutter. The motor is supported by a bracket provided for the purpose.

When the threads of bronze valve cages have become so worn they will not keep in place, they are again made usable by the use of a special swedge, which is forced into them under a hydraulic press. As illustrated in Fig. 3, a bushing limits the travel of the swedge. A nut is used to remove the swedge from the work after the operation has been completed. This simple device practically doubles the life of valve cages.

Another practice, effective in reducing costs, is that of rebeading copper gaskets by means of embossing dies. A helper can put a large pile of gaskets through the press in an hour or two and restore them to their original tightness.

By-pass grooves in the cross-compound air pumps are cut by still another special tool after they have been rebushed. This device is shown, in Fig. 4, in place on an 8½-in. cylinder. The grooves, which are really half holes, are cut with an end mill guided by a special fixture which fits in the bore and is clamped in place by a screw provided for the purpose. The fixture has three bushed holes which come opposite the edge of the bore so that only half the cutter is in the work. In this case, also, the air drill is used as a source of power.

Probably every air brake shop has its own method of attaching hose fittings. In the particular shop visited, a homemade arrangement is used, which is capable of putting heads and nipples on 400 hoses in the course of an 8-hour day. The hose is first clamped in wooden V-blocks which are forced together by the inclined air cylinder shown at the front of Fig. 5. A second cylinder at the back of the base pushes the fittings into the hose. The hose is



These shop-made devices save time and promote accuracy in the overhaul of air brake parts

then withdrawn until the fitting comes between two other cylinders, the pistons of which are attached to either side of a toggle device. When the air is turned on, the fittings, which have already been slipped over the end of the hole, are gripped on both sides by the toggle jaws and forced together. The clamping bolt is inserted and tightened to hold the fitting in place. The air pressure is then released, and the hose reversed to install the fitting in the opposite end.

Bronze slide valves are lapped in by reciprocating them vertically by means of a simple crankshaft arrangement. Small flat springs keep a uniform pressure between the slides and their seats. All slide valve parts are kept together in a box so that each set may be reassembled in its original combination. This precaution minimizes the work of lapping and fitting. After overhauling, the valves are tested on a standard A.R.A. test rack.

Pistons Are Salvaged

Pistons for pump cylinders are salvaged by acetylene welding with phosphor bronze weld rods. In preparation for this operation, they are turned down $\frac{1}{8}$ in. below the smallest bore that they may be used with and are then welded to $\frac{1}{8}$ in. above the largest bore. This leaves enough stock to turn them to the maximum size required. A supply of welded pistons is kept on hand to be fitted to cylinders, as needed. The welds have never caused any difficulty.

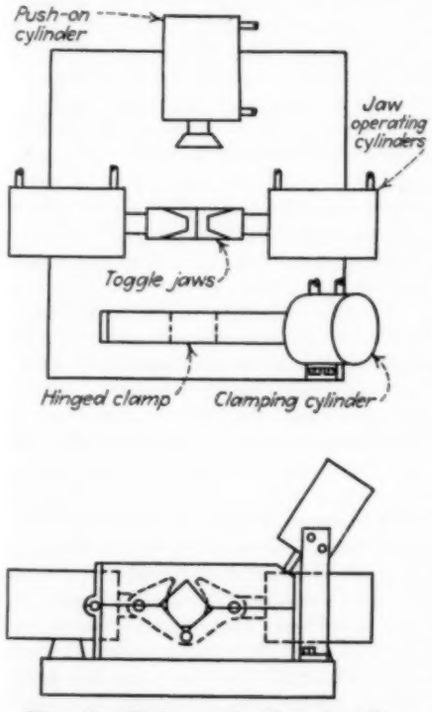


Fig. 5—High production is obtained by the use of this pneumatically operated fixture for fitting couplings to air hoses

Globe valves and other bronze parts when received at the shop are given a lye wash to eliminate dirt and grease. This leaves the bronze parts with a dark appearance so they are next dipped into dilute sulphuric acid. By this means the caustic is neutralized, and the valves and fittings are given a clean, bright appearance. As a result, when they leave the repair shop, they look like new. Precautions like this give the train crews a pride in their equipment and are an added incentive to keep it in good condition.

Starting a New Shop on Old Lines—Discussion

M. P. DALTON
Kemsing, Sevenoaks, England

I would like to meet that man in Syracuse of whom Godfrey tells up (*AM*—Vol. 77, page 537). During the last fifteen years, I have reorganized seven shops and the scheme has been similar in each case. Generally, there has been no change or interference in technical methods except to improve the comfort of the workers. In the first case, three thousand men were concerned and the factory had a complete and detailed organization. All that was done was to secure the returns being correct and prompt and then to use them. This last point is the essential and is missed in all technical school courses.

There are principles behind management and these are not taught. Take progress as a sample. Too often, the aim of the progress department is to prepare wonderful charts which are admired by everybody and used by none. The laws of statistical analysis are the essential effort of the progress system and unless these are used, the system is costly and largely a failure. The necessity in scientific management is to discover what is wrong—not how to do better in everything. Doing better all round is not always necessary or desirable. It may seem unorthodox, but it is true, to state that management is not often difficult provided that the right facts are discovered. State the problem fully and there are many who can give a good solution. But very few can state the proposition fully or rightly.

In the factory mentioned above, the system was made to operate promptly and then simplified. Many of the forms were cut out or combined. Responsibility was first centralized to secure knowledge and then spread to secure quick operation. The result was a fivefold increase of output in 18 months.

Some of the reasons were: provision of stock orders not previously considered. This diminished progress work greatly both in the office and shops. Material deliveries were brought up to date. Delays amounting to half the working time are quite common in some big shops. My experience in various shops has shown that without technical improvement but with real knowledge of facts, the desired ends have been attained without expense. Here we come to Godfrey's summary—"general information plus simple office records."

One effect is that the estimators and foremen do the planning to an arranged plan, but the records go to the office for examination. It would surprise many newly-trained managers to know how rarely difficulty occurs under such circumstances either in delivery or price. Generally, one does not worry about progress because the manager will know as soon as everything is not O.K. And that is management, scientific but simple.

Standardizing Machined Surfaces

Work is progressing on the standardizing of machined surfaces. Subgroup No. 2, of the Sectional Committee of the A.S.M.E. handling this work, met on Dec. 6, 1933 under the chairmanship of J. S. Chafee and decided, for the present at least, to restrict the work to surfaces produced by milling, planing and turning. Samples of finished work are to be solicited only from manufacturers of machine tools at present, this decision being recommended by user company representatives. The committee desires samples of what each plant considers the minimum number of standard classifications for the surfaces produced by their various machines and recommendations as to the use of each classification.

In order to secure uniformity the sample surfaces are to be made on SAE 1020 steel, to be $2\frac{1}{2}$x$2\frac{1}{2}$x$\frac{3}{8}$ in. for flats and 1 in. diameter by 4 in. long for rounds, except where larger samples may be necessary, as for very coarse feeds. G. B. Hogaboom of the Hanson-Van Winkle-Munning Co. offered to have the samples cadmium plated to preserve the surfaces. This plating can be so thin as to preserve all the qualities of the surface beneath and yet protect it from corrosion. The next meeting will be in conjunction with the subgroup on finishes produced by abrasives.

The chairman desires those who plan to submit samples to communicate with him at once in care of the Brown & Sharpe Mfg. Company, Providence, R. I. February 20 is set as the last date for submitting samples.

Valve Seat Inserts

A. T. COLWELL
Chief Engineer, Thompson Products Company

Not a new idea but one finding increased favor is the use of valve seat inserts. The author discusses materials and methods of installation

PROBABLY no part of an automobile cylinder block is subjected to more severe conditions than the exhaust valve port. A hot flame plays over this port during scavenging, and a short distance away is the cooling water, causing a large change of temperature within about a half inch. The outer skin of material at the port seat will be very hot as the flame plays over it during exhaust. In addition, the exhaust valve seat in the block must receive the impact of the valve during seating. This impact will vary tremendously under different conditions. In some cases it cannot even be calculated.

Add to this a sloppy guide, allowing valve slap, a cylinder head pulled down unevenly setting up strains to cause weaving as the block heats, uneven cooling of the block seat caused by core washing or design, and all the elements are present for serious trouble. Ordinary gray iron valve seats can hardly be expected to operate successfully under such conditions.

Cast iron block seats often cause "pick-up" or "warts" on the exhaust valve. Any valve containing chromium has a tendency to pick small particles of iron from the block when both block and valve seat are hot. These are probably small particles of iron which soon become iron oxide on the valve seat and file hard. They unseat the valve and gouge the block, particularly if the valve turns. Aluminum bronze will sometimes cause "pick-up" on the valve seat, but it is not hard enough to injure the seat and usually not thick enough to unseat the valve. After a cylinder-block valve has been refaced a few times, either an oversize valve must be used or a valve-seat insert must be installed. Service men long ago learned to save expensive blocks with seat inserts, even though the inserts used were only gray iron.

To meet adverse valve-seat conditions, engineers have turned to valve-seat inserts as a solution, the purpose being to put a small amount of good material in the proper place. Regardless of the amount of cooling water used, cast-iron block seats will not stand up under some conditions. Excessive cooling is undesirable from an efficiency standpoint and is often expensive and impractical. The simplest and best solution is a good valve-seat insert. The use of inserts is not new. They have been used in airplane engines for years, as aluminum is not a satisfactory valve seat. The problem has been to find a comparatively cheap satisfactory seat for cast-iron blocks.

Characteristics Required

A good seat insert should have good conductivity, high hardness of approximately 50 Rockwell C, should have a coefficient of expansion close to that of gray iron, and should be metallurgically stable at operating temperatures. This indicates that it should not draw and must have no volume change. It should have oxidation and corrosion resistance to a fair degree. It should grind freely, and the low coefficient of expansion indicates that it should be installed with a press fit, eliminating the necessity for threading, pinning, welding or tapering. It should never cause pick-up or warts even under the worst conditions, should last during the life of the engine, and should be cheap.

The inserts proving most satisfactory today are not machinable but are ground after installation. Grinding equipment is now on the market, and the work can be done quickly and easily. The permanence of the job justifies the slight additional work of installation.

Aluminum bronze is widely used for airplane motors. Its high coefficient of expansion allows it to work well in aluminum cylinder heads. Its heat conductivity is high. It is not successful in cast iron blocks because of its high expansion coefficient. It must be anchored in some manner and then is usually loose when cold.

Valve materials have been tried as seat inserts. The high expansion rate causes the seats to loosen in the block, although these materials otherwise have good properties.

Elkonite, a mechanical mixture of copper and tungsten, has comparatively low expansion, but is not highly heat resistant and is expensive. Its heat conductivity is good.

Ni-Resist, a copper nickel cast iron, has been used in some automotive engines using an aluminum head. Its high expansion rate makes it suitable for this work, but it is not suitable for use in a cast iron block. It does not cause "pick-up."

High-Speed Steel Used

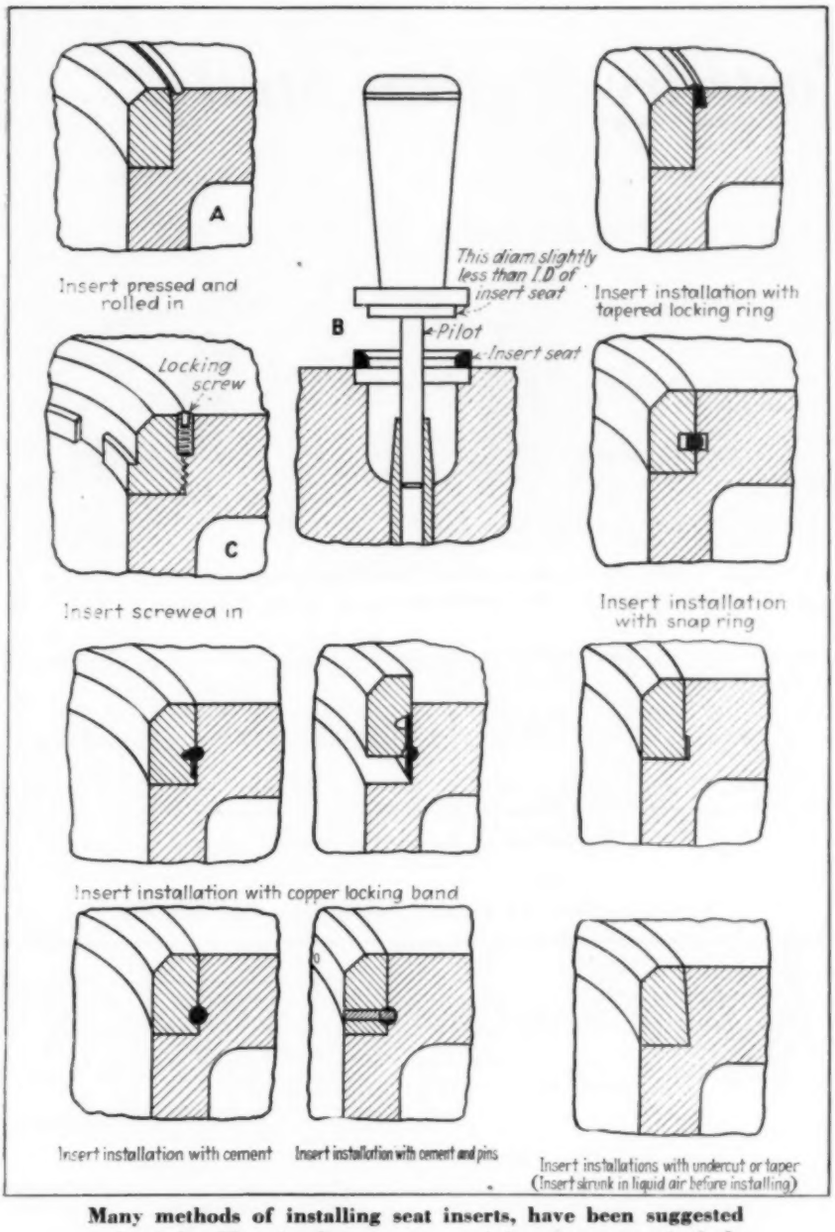
High-speed steel has been quite extensively used and has many desirable properties. It is a good seat insert, has a fairly low coefficient of expansion and good heat conductivity. It maintains hardness satisfactorily but has a tendency to load the grinding wheel. It is comparatively cheap.

Cast irons with small additions of alloy have been used and are an improvement over gray iron. They are soft and machinable but do not last as long as a hard seat.

Stellite puddled on a steel ring is used in some cases. The steel ring is then assembled in the block, usually by threading. The stellite itself is a fine seating material and gives good results. It retains hardness at operating temperature, has no tendency to "pick-up" and tappet clearance is maintained. From a production standpoint, the puddling operation is slow and expensive, and excellent technique is necessary to prevent blow holes, scaling of the steel and cracking. The soft steel backing is, in most cases, threaded into the block, which adds expense to the job. This combination has found favor in several truck motors and performs very well.

A semi-steel ring, called Duracrome, now in use, has performed exceptionally well. It has all the characteristics necessary for seat insert material. When properly heat-treated it develops a hardness of over 50 Rockwell C, and maintains this hardness during motor operation. The material is an alloy of molybdenum, chromium, silicon, carbon and iron. The nature of the alloy is that of white iron, with all the carbon in solution, there being practically no free graphite. The material has a coefficient of expansion very close to gray iron, and will stay tight in the block with a press fit of 0.003-0.005 in. in the smaller sizes. This has been demonstrated in both L-head and valve-in-head motors. Tappet clearance is maintained, valve life increased, and con-

Abstracted from a paper presented before a sectional meeting of the S.A.E. in Cleveland.


A
Insert pressed and rolled in
This diam slightly less than I.D of insert seat
Insert installation with tapered locking ring
B
Pilot
Insert seat
Locking screw
C
Insert screwed in
Insert installation with snap ring
Insert installation with copper locking band
Insert installation with cement
Insert installation with cement and pins
Insert installations with undercut or taper (Insert shrunk in liquid air before installing)

Many methods of installing seat inserts, have been suggested and tried. The simpler ones are gaining favor, particularly with the use of low expansion materials

tinued good performance has been found. The seat must be ground, but the trend is toward hard seats to obtain their added properties. With hard seat inserts, even though the block weaves, the insert remains fixed, assuring good seating for the valve.

Seats of Duracrome and high-speed steel are ordinarily installed with a press fit as at *A*. This fit in the smaller sizes is 0.003-0.005 in., increasing slightly for the larger sizes. Too great a press fit will cause scraping of the block with little fit remaining. The press fit allows good contact for heat transfer and is satisfactory. In some cases the iron of the block is rolled or peened over a bevel on the outer diameter of the seat for added security. When the block is properly prepared, the seat will be only slightly eccentric with the guide after installation. It is quickly touched with grinding equipment now available and made concentric.

The seats may be pressed in with an arbor or tapped in by hand with a tool as shown at *B*. The latter method is quick and simple. The tool pilots in the guide, also on the inside diameter of the seat, and the force is applied to the top of the seat. This is important, as force applied to the bevel will tend to spread the seat. Just before the insert touches the bottom of the counterbore, chips and dirt should be blown out with an air line, and then insert seated. One hundred and ten blocks per hour have been put through a single production line and all inserts held to an indicator reading of 0.001 in. with the guide.

A combination freeze and press fit is also sometimes used with Duracome and high-speed steel. Dry ice gives a temperature of about —100 deg. F., and liquid air about —200 deg. F. The seats are placed in a refrigerator on the assembly line, and contract with the cold. The contraction in diameter with dry ice will be 0.001-0.0015 in. and with liquid air about 0.0025 in. in the smaller sizes. The inserts are then quickly installed, a slightly smaller press fit being used. Good practice is to install seats immediately after the block leaves the washer, and it is then hot and will contact slightly on the seat inserts

Seats of higher expansion materials are usually threaded in the block, and sometimes a rust producing material is smeared on the threads to bind the seat to the block as shown at *C*. This threaded fit must be tight, considerable force being necessary to screw the seat into place. Sometimes a soft washer is used at the bottom of the counterbore. This may also be pinned to place for added security. This installation is satisfactory with all but those materials having a high coefficient of expansion.

Setting Tolerances Discussion

C. G. WILLIAMS

There is one factor in the setting of tolerances which it seems impossible to beat into the heads of many engineers, some of whom occupy high places. They cannot seem to realize that no matter what tolerance is set on the drawing, the actual tolerance on the piece is the one set by the jig or fixture used in its manufacture. It is frequently overlooked that the actual tolerance allowable must be half of the tolerance on the drawing. Taking John R. Godfrey's example (*AM*—Vol. 77, page 638) with the holes out three to four tenths, the resulting machine tolerance could be from six to eight tenths, irrespective of what was on the drawing.

I tried to point this out to a chief engineer when designing a jig for grinding a certain machine part, whose dimension was +0.005—0 in. I tried to show the C.E. that were the jig made for a tolerance of 0.005 in. the piece would come out 0.010 in. The parts showed an actual dimension of ±0.010 or 0.020 in. as between minimum and maximum. The jig was rebuilt and the tolerance was set 0.001 in. above the drawing tolerance. This was 0.875 + 0.005 in. The figures in the drawing for the jig were set at 0.876 ± 0.001 in. This brought the required machine tolerance on one side 0.875—0 and on the other side to 0.875 + 0.002 in., which was easily met.

Cutting Costs by Motion Study

RALPH M. BARNES
Associate Professor of Industrial Engineering, College of Engineering, University of Iowa

Effective utilization of labor on simple assembly jobs depends on motion analysis and layout of equipment to permit both hands to perform work. Savings? The case cited showed 35 per cent less time involved

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THE SHOP manager is constantly confronted with the problem of reducing costs. A depression only makes this task more vital.

There are many ways in which cost reductions can be brought about. Some of the plans require considerable capital investment for new machines—special automatic equipment or the like. Many plants are not in position to add greatly to their capital investment these days. There is, however, a technique which is certain to bring about substantial savings in production costs in many kinds of work, and this is motion study.

Motion study takes on greater importance at the present time because little or no outlay need be made for equipment or apparatus to bring about cost reductions. Also, motion study may be applied in the small shop as well as in the larger factory. Most people do not know how to work effectively unless instructed in the proper method.

The application of the principle of motion economy makes possible increases in output of from 20 to 100 per cent without asking the employees to work harder.

In order to illustrate how a careful analysis of the motions required to perform a task may aid in finding a better method, a specific case will be cited.

A two-plate clamp, Fig. 1, consisting of two steel plates, $\frac{5}{8}$x2$\frac{3}{8}$x$\frac{1}{8}$ in., two bolts, 1$\frac{5}{8}$x$\frac{3}{8}$ in.; two lockwashers, and four nuts was needed in quantity. The method of making this assembly was as follows: The operator picked up two plates with one hand, assembled one

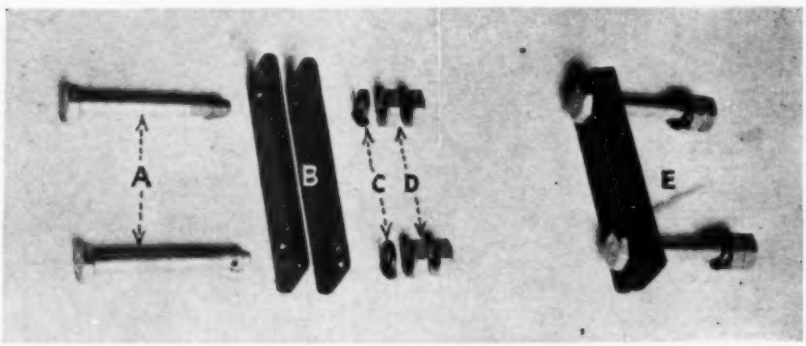

Fig. 1—Two-bolt clamp assembly which was the subject of the motion-economy study described

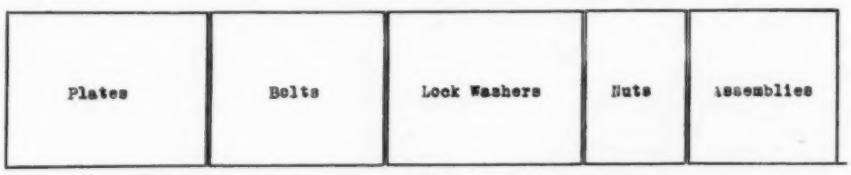

Fig. 2—Layout of the workplace—old method

Analysis Sheet of Clamp Assembly—Old Method

LEFT HAND	RIGHT HAND
1. Reaches for two plates	1. Reaches for bolt
2. Selects and grasps two plates	2. Selects and grasps bolt
3. Carries two plates to assembly position	3. Carries bolt to assembly position
4. Holds two plates	4. Waits for left hand
5. " " "	5. Positions bolt for assembly
6. " " "	6. Assembles bolt into hole in plates
7. " " "	7. Releases bolt
8. " " "	8. Reaches for lock washer
9. " " "	9. Selects and grasps one lock washer
10. " " "	10. Carries lock washer to bolt
11. " " "	11. Positions lock washer
12. " " "	12. Assembles lock washer
13. " " "	13. Releases lock washer
14. " " "	14. Reaches for nut
15. " " "	15. Selects and grasps nut
16. " " "	16. Carries nut to bolt
17. " " "	17. Positions nut
18. " " "	18. Assembles nut
19. " " "	19. Releases nut
20. " " "	20. Reaches for second nut
21. " " "	21. Selects and grasps nut
22. " " "	22. Carries nut to bolt
23. " " "	23. Positions nut
24. " " "	24. Assembles nut
25. " " "	25. Releases nut
26. Turns plates into new position	26. Turns plates into new position
27. Holds two plates	27. Releases plates
28. " " "	28. Reaches for second bolt
29. " " "	29. Selects and grasps bolt
30. " " "	30. Carries bolt to plates
31. " " "	31. Positions nut
32. " " "	32. Assembles bolt
33. " " "	33. Releases bolt
34. " " "	34. Reaches for lock washer
35. " " "	35. Selects and grasps lock washer
36. " " "	36. Carries lock washer to bolt
37. " " "	37. Positions lock washer
38. " " "	38. Assembles lock washer
39. " " "	39. Releases lock washer
40. " " "	40. Reaches for nut
41. " " "	41. Selects and grasps nut
42. " " "	42. Carries nut to bolt
43. " " "	43. Positions nut
44. " " "	44. Assembles nut
45. " " "	45. Releases nut
46. " " "	46. Reaches for second nut
47. " " "	47. Selects and grasps nut
48. " " "	48. Carries nut to bolt
49. " " "	49. Positions nut
50. " " "	50. Assembles nut
51. Carries finished assembly to left and drops it into box	51. Release nut

bolt through the holes, assembled the lockwasher and the two nuts onto the bolt. Then she picked up the second bolt, assembled it through the holes in the plates, picked up the lockwasher and assembled it, and then picked up the nuts and assembled them. Fig. 2 shows how the parts were arranged on the bench. Underneath is given a detailed analysis of the elemental motions of the right and left hands in making the assembly in this way. It will be noted that the left hand was used most of the time for holding the piece while the right hand was working productively. This at once suggests the possibility of using some device to hold the piece so that both hands might be free to assemble plates, washers and nuts.

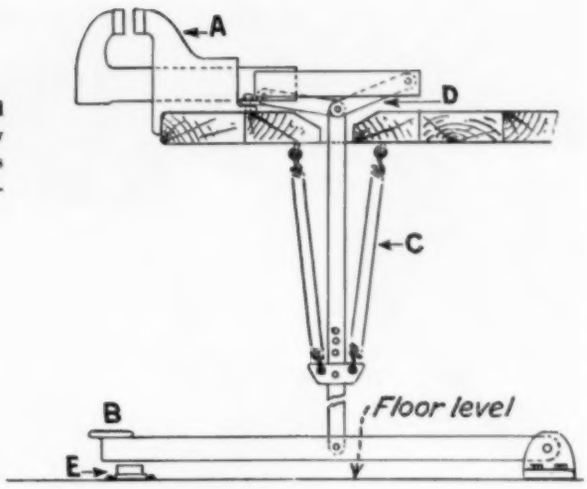

Fig. 3 — Foot-operated vise devised to allow both of the operator's hands to perform useful work

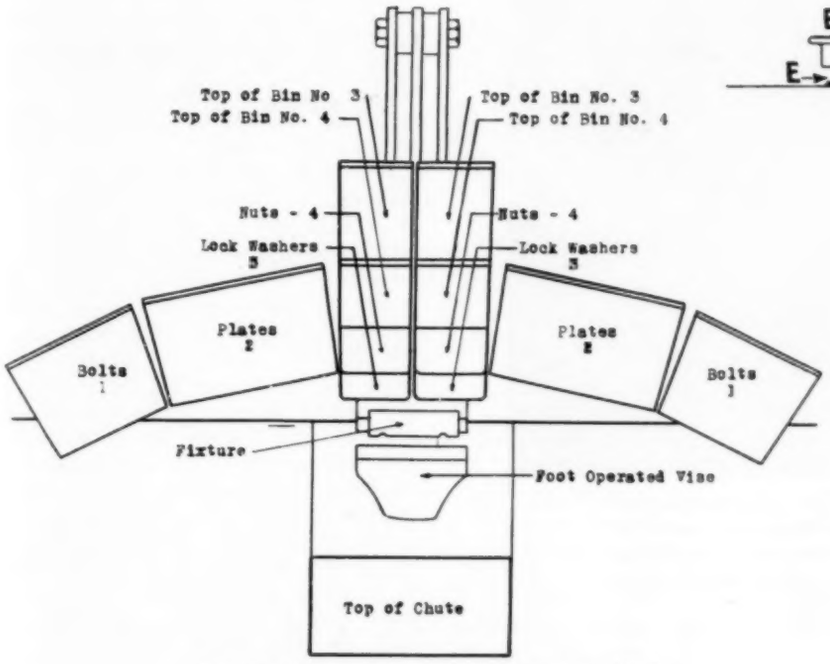

Fig. 5—Layout of workplace—new method

Motion-Economy Principles

A foot-operated fixture of some kind would perhaps be the first device to be considered by those experienced in the application of motion economy principles. Fig. 3 shows how the ordinary bench vise may easily be converted into a foot-operated one. Pressing the pedal opens the vise and releasing the pedal allows the two powerful springs to close the vise. The toggle action at *D* may be used further to increase the gripping power of the vise. It is a simple matter to make a small fixture and mount it on one jaw of the vise to serve as a retainer for the bolts while they are being clamped in position in the vise.

Other principles of motion economy that can be brought into use in this operation are: (a) materials should be located close to the point of the assembly and *around* the point of use; (b) motions of the arms should be in symmetrical directions, instead of in the same direction, and should be made simultaneously; (c) gravity feed containers should deliver the material close to the point of use, and (d) a chute should be used to carry away the finished assemblies.

The application of these principles is possible in the new setup shown in Figs. 4 and 5. The standard steel bins which may be nested one above the other are used for supplying the material at the desired point. Duplicate material containers are used for the parts so that both the right and left hands can work effectively. This permits the two hands to move together in opposite directions and this in itself reduces fatigue. A metal chute is

Analysis Sheet of Clamp Assembly—New Method

LEFT HAND	RIGHT HAND
1. Reaches for one bolt	1. Reaches for one bolt
2. Selects and grasps bolt	2. Selects and grasps bolt
3. Carries bolt to vise fixture (Vise is held open by depressed foot pedal)	3. Carries bolt to vise fixture (Vise is held open by depressed foot pedal)
4. Positions bolt in fixture	4. Positions bolt in fixture
5. Holds bolt while closing vise by releasing foot pedal	5. Hold bolt while closing vise by releasing foot pedal
6. Releases bolt	6. Releases bolt
7. Reaches for one plate	7. Reaches for one plate
8. Selects and grasps plate	8. Selects and grasps plate
9. Carries plate to position above bolts	9. Carries plate to position above bolts
10. Positions one plate on top of other	10. Positions one plate on top of other
11. Moves plates to bolts	11. Moves plates to bolts
12. Positions plates	12. Positions plates
13. Assembles plates onto bolts	13. Assembles plates onto bolts
14. Releases plates	14. Releases plates
15. Reaches for one lock washer	15. Reaches for one lock washer
16. Selects and grasps lock washer	16. Selects and grasps lock washer
17. Carries lock washer to bolt	17. Carries lock washer to bolt
18. Positions lock washer	18. Positions lock washer
19. Assembles lock washer	19. Assembles lock washer
20. Releases lock washer	20. Releases lock washer
21. Reaches for nut	21. Reaches for nut
22. Selects and grasps nut	22. Selects and grasps nut
23. Carries nut to bolt	23. Carries nut to bolt
24. Positions nut	24. Positions nut
25. Assembles nut	25. Assembles nut
26. Releases nut	26. Releases nut
27. Reaches for second nut	27. Reaches for second nut
28. Selects and grasps nut	28. Selects and grasps nut
29. Carries nut to bolt	29. Carries nut to bolt
30. Positions nut	30. Positions nut
31. Assembles nut	31. Assembles nut
32. Removes finished assembly from vise (opens vise with foot) and carries assembly to top of chute and releases.	32. Removes finished assembly from vise (opens vise with foot) and carries assembly to top of chute and releases.

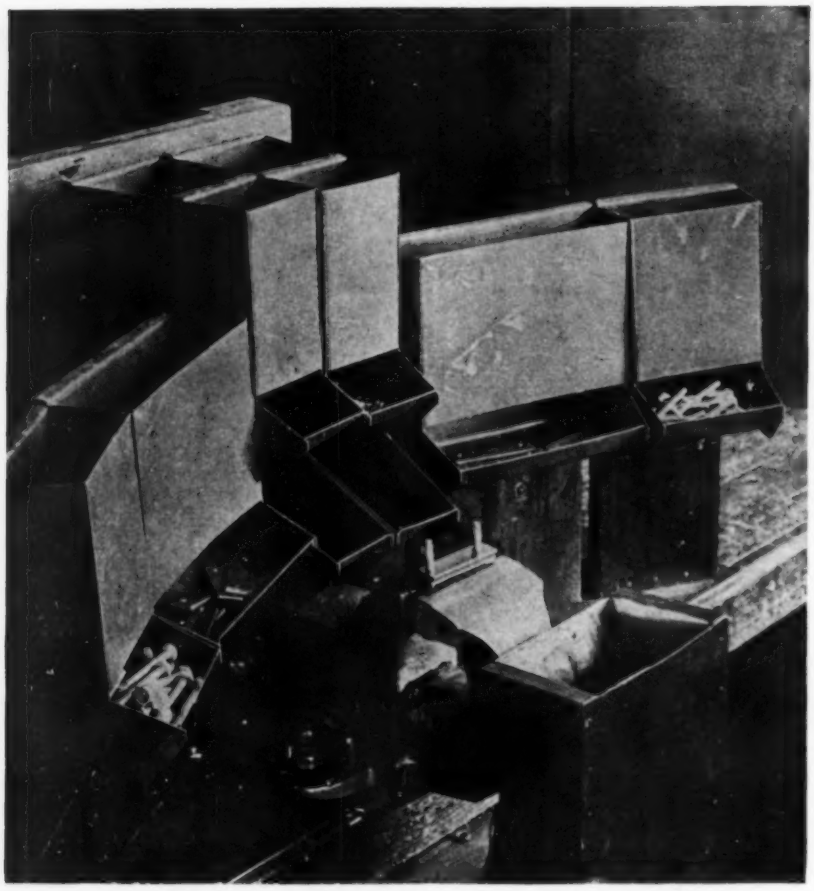

Fig. 4—Bins, vise and chute for motion-economy assembly. Arranged in a curve and duplicated on either side of center, this bench layout achieves symmetrical movements for both hands, higher output and lessened fatigue of the operator

placed directly in front of the operator so that the finished assemblies may be disposed of easily and quickly. The parts are carried down under the bench to a tote box.

New Method

Using this new method the operator reaches with her right and left hands to bins No. 1, Fig. 5, and grasps a bolt with each hand, inserts the two bolts head down against the fixture on the vise jaw and releases the pedal which clamps the bolts in place. She then reaches for a plate from each bin No. 2, places one on top of the other as she carries them into position above the two bolts which project above the vise jaws. She assembles the plates onto the bolts, and then grasps a lockwasher with each hand from bins No. 3 and assembles them onto the bolts. From bins No. 4 she grasps a nut in each hand and assembles them, then assembles a second nut on each of the two bolts. As the second nut is run down flush with the end of the bolt the vise is opened by depressing the pedal. The assembly is removed from the vise, carried an inch or so to the top of the chute and released. This completes the cycle. Below Fig. 5 is given a detailed analysis of the elemental motions of the left and right hands in making the assembly in the new way.

This new method complies with the principles of motion economy named above. The two hands move simultaneously in opposite directions, which permits the operator to develop a rhythm. These balanced movements to the right and left of the operator's body reduce fatigue. Neither hand is used as a holding device in the new method as the vise does that work. The bins deliver the parts close to the assembly point and the chute carries the finished parts away. Thus the two hands are able to work effectively and all the unnecessary motions have been eliminated.

By comparing the analysis sheet Fig. 3 of the old method with that of the new method Fig. 5, it is seen that the operator makes 51 motions as against 32 motions. Time studies show the new method to be approximately 35 per cent shorter than the old method.

Lubrication—Cost and Economy—Discussion

W. R. NEEDHAM
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John R. Godfrey, in his "Seen and Heard" notes, (*AM*—Vol. 77, p. 478) generally deals with live topics. Lubrication is certainly one of these. The layman is often surprised at the difference a drop of oil makes, judiciously applied, when he tries to turn a shaft by hand. But few laymen and engineers understand that it is possible in certain cases to over-oil parts of machinery. It was once considered good practice to keep journals and bearings as nearly cold as feasible. To this end the crudest forms of water cooling were sometimes resorted to, with bad effects on the shaft material.

It is now possible to calculate with some degree of precision the friction loss in journals, at least, where many of the better known commercial oils are concerned. It is also possible to estimate rough equivalents of the natural heat dissipation from the bearings and pedestals in use. Hence, an approximate value can be derived for the temperature balance likely to be realized for the particular job. Even for such highly important machinery as water and steam turbine sets, it is becoming recognized practice to allow a bearing temperature of 140 deg. F. where formerly many of the leading engineers regarded 120 deg. F. as unwarrantably high. The consequent savings in friction loss by cooling only from 140 deg. F. can be very considerable.

Setting Tools Accurately Discussion

GEORGE BELBES

In an article under the title given above (*AM*—Vol. 77, page 732), Peter L. Budwitz describes a method of setting an end mill central with the work in a milling machine, the work being of cylindrical form.

A more accurate, rapid and direct method of accomplishing the setting would be by means of a surface gage, a height gage, or vernier having an indicator attached. Knowing the diameters of the work and the cutter, respectively, it is necessary only to take a reading at the upper part of the periphery of the work, adjust the vernier an amount equivalent to the difference of the radii of the work and the cutter, and then raise or lower the machine table until a corresponding reading of the indicator is obtained over the periphery of the tool.

Checks on Gear Tooth Accuracy

IVOR J. GRUENBERG
Engineer, Gear Grinding Machine Company

Pin measurement at the constant chord is recommended for final inspection of spur and helical gears

IN A general way, a finished gear is subjected to these inspection tests: The tooth spacing is tested, the tooth thickness is usually checked, the curve of the tooth profile is determined, the concentricity of the gear teeth and bore is inspected and, finally, the diametral position of the involute is found. If the gear happens to be helical or a worm, the lead and helix angle are also determined.

The diametral position of the involutes bounding the gear teeth is usually checked in this manner: Two pins of known diameter are placed into diametrically opposite tooth spaces of the gear and a micrometer reading over the pins is taken. The dimension over the two pins is a function of the tooth thickness, the tooth spacing, the nature of the tooth curve, and the pitch diameter. In a helical gear or a worm, the helix angle, or lead, also influences the dimension over the two pins. Any difference, then, in the dimension over the two pins, from the computed theoretically correct dimension, may be caused by any one or all of the above mentioned influences.

It is, therefore, at times difficult to determine precisely which one of the above factors is causing the discrepancy. However, practice has shown that, if the dimension over the pins in a gear checks with the computed theoretically correct figures, all the influencing factors mentioned are likely to be correct. Checking a gear with two pins and a micrometer does not eliminate the necessity for all previously mentioned tests to which a gear is generally put; it does, however, give a simple, rapid, accurate and reliable indirect check of all the influencing factors which together make up the gear.

If the tooth spacing, concentricity, tooth curve and lead, or helix angle (in the case of a helical gear or worm), have been checked in a gear and found correct, the dimension over the two pins is a direct measure of tooth thickness and a very accurate one. It is next to impossible to determine the tooth thickness or a helical gear or worm with gear tooth calipers. Anyone familiar with helical gears or worms will agree that at best it is a poor approximation.

To arrive at a micrometer reading for the diametral position of the involute several methods of calculation are now employed:

1. To calculate the diameter of pin, which will contact the involute at the pitch line and from this determine the dimension over the two pins placed in diametrically opposite tooth spaces.
2. To assume a pin diameter and then compute the dimension over the pins placed diametrically opposite each other in tooth spaces.
3. To make two V-blocks of known dimensions and proper included pressure angle, and then compute the dimension over the blocks placed in diametrically opposite tooth spaces.

There are several variations of the above methods, such as the tangential pressure line method and the three pin method, which are employed now and then. The three mentioned are the most generally used in every day practice. All of the above methods give satisfactory results but have disadvantages and shortcomings under certain conditions. The writer in his experience has found the following:

The first method mentioned has this shortcoming. With a small diametral pitch tooth, and this is particularly true of helical gears, the pins are necessarily of a small diameter. Consequently it is rather difficult to check the distance over the pins with ordinary micrometers. The author has had cases in which it was difficult to ascertain whether the micrometer anvil contacted the top of the gear teeth or rested squarely on the checking pins. Selecting a pin of larger diameter naturally overcomes this difficulty (which is the case in the constant chord method).

In the second method given, in which the pin diameter is assumed, the computation necessary to arrive at the dimension over the pins is entirely too lengthy and, therefore, out of the question for ordinary shop use. Another danger in connection with this method is the fact, that a pin of a diameter a little too large may be selected, which would contact the involute rather high. It is not uncommon practice to modify the involute of a gear tooth, especially in a region near the top of the tooth. Any variation of the involute at the pin contact naturally changes the dimension over the pins.

The chief objection to the third method is the expense of making V-blocks and those to precision dimensions. It does not seem possible that all the dimensions of two V-blocks can be held to limits as close as the diameter of two pins.

The constant chord method described in this article has been tried and not found wanting in the above given respects. The final formulas are simple and any one should have good results with their use.

It is a known fact that all gear teeth of the same pitch have what is called a constant chord, located at a fixed height above the pitch circle. In this method, the diameter of the pin which contacts the involute at the constant chord is determined, and the dimension over two pins placed in diametrically opposite tooth spaces computed.

In the case of helical gears and worms, the objection is often voiced in regard to the fact that the pins have a tendency to rock when placed into the tooth spaces. The pins do rock, but no difficulty in obtaining a micrometer reading is encountered if it is remembered that it is the minimum distance over the pins that is required. By keeping the micrometer anvils diametrically opposite each other and the whole instrument in a plane normal to the axis of the gear or worm, it is possible to obtain an accurate minimum reading.

The following steps are taken to arrive at the required formulas for spur gears:

Fig. 1 shows a spur tooth of circular pitch P.

Given: ϕ = pressure angle.

arc af = ad and arc $a'f$ = $a'b'$

But ab = $a'b'$

bd = arc aa' = arc mm'

From geometry: $\frac{mm'}{ao} = \frac{bb'}{bo}$

or $mm' = bb' \frac{ao}{bo} = bd$

But $\frac{ao}{bo} = \cos\phi$ Then $bd = bb' \cos\phi$

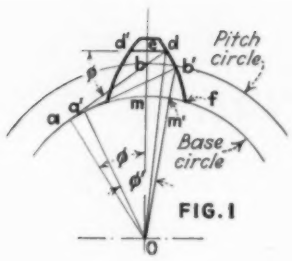


FIG. 1

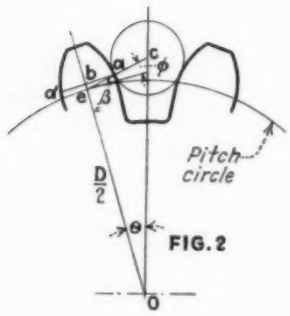


FIG. 2

$$bb' = \frac{P}{4} \qquad bd = \frac{P}{4}\cos\phi \quad (1)$$

$$ed = bd\cos\phi = \frac{P}{4}\cos^2\phi$$

And the whole chord $dd' = \frac{P}{2}\cos^2\phi$ (2)

This chord must be constant for any gear of this diametral pitch, since both P and ϕ are constant.

The height increment is not used in determining the pin size nor is it necessary for determining the dimension over the pins. But, since it has been mentioned it may be well to give its derivation. It may be used with the constant chord to check the tooth thickness with a pair of tooth calipers. Again referring to Fig. 1:

$$be = bd\sin\phi$$

From Equation 1: $bd = \frac{P}{4}\cos\phi$

$$\text{Therefore } be = \frac{P}{4}\cos\phi\sin\phi$$

From trigonometry:

$$\sin 2\phi = 2\sin\phi\cos\phi$$

$$be = \frac{P}{8}\sin 2\phi \quad (3)$$

Since P and ϕ are constants for a given diametral pitch be is a constant height.

For a gear tooth of circular thickness T, Formula 2 becomes:

$$be = \frac{T}{4}\sin 2\phi \quad (4)$$

In Fig. 2 is shown a pin of radius ac contacting the involute spur tooth at the constant chord aa'.

Given: pressure angle = ϕ, number of teeth in gear = N, circular tooth thickness = T, pitch diameter = D,

$$\theta = \frac{180^\circ}{N} \qquad \triangle = \frac{90^\circ}{N}$$

and $\beta = 90^\circ + \phi$

$$\text{Constant chord} = aa' = \frac{P}{2}\cos^2\phi$$

Substituting T for $\frac{P}{2}$ we get:

$$aa' = T\cos^2\phi$$

$$\frac{aa'}{2} = ba = \frac{T\cos^2\phi}{2}$$

$$ea = \frac{ba}{\cos\phi} = \frac{T\cos^2\phi}{2\cos\phi} = \frac{T}{2}\cos\phi \quad (5)$$

From trigonometry:

$$ec = \frac{D}{2}\,\frac{\sin\theta}{\sin(\theta+\beta)}$$

$$\sin(\theta+\beta) = \cos(\theta+\phi)$$

$$\text{Therefore } ec = \frac{D}{2}\,\frac{\sin\theta}{\cos(\theta+\phi)} \quad (6)$$

$$ac = ec - ea = \frac{D\sin\theta}{2\cos(\theta+\phi)} - \frac{T\cos\phi}{2}$$

Diameter of pin = $d = 2ac =$

$$\frac{D\sin\theta}{\cos(\theta+\phi)} - T\cos\phi \quad (7)$$

Which is the diameter of the pin required.

$$oc = \frac{D}{2}\,\frac{\sin\beta}{\sin(\theta+\beta)}$$

$\sin\beta = \cos\phi$ and $\sin(\theta+\beta) = \cos(\theta+\phi)$

$$\text{Then } oc = \frac{D}{2}\,\frac{\cos\phi}{\cos(\theta+\phi)} \quad (8)$$

The dimension over the pins then $= d + 2oc$

$$\text{or } d + \frac{D\cos\phi}{\cos(\theta+\phi)} \quad (9)$$

which is the equation for the distance over pins for a spur gear having an even number of teeth.

For a spur gear having an odd number of teeth Equation 9 becomes:

Dimension over pins =

$$d + \cos\triangle\left(\frac{D\cos\phi}{\cos(\theta+\phi)}\right) \quad (10)$$

The following equations apply to helical gears and worms. The derivation of these expressions is not given because of the difficulty encountered in trying to supply adequate sketches. They are nevertheless true and have been tried out in actual gear grinding practice.

Given: P_n = normal circular pitch.
a = helix angle
ϕ_n = normal pressure angle
ϕ = diametral pressure angle
N = number of teeth in gear
D = pitch diameter
T_n = normal tooth thickness

$$\theta = \frac{180\cos^3 a}{N}; \qquad \triangle = \frac{90}{N}$$

$$\text{constant chord} = \frac{P_n}{2}\cos^2\phi_n$$

$$= T_n\cos^2\phi_n \quad (11)$$

$$\text{Height increment} = \frac{P_n}{8}\sin^2 2\phi_n \quad (12)$$

d = diameter of pin which contacts involute helicoid at constant chord.

$$d = \frac{D\sin\theta}{\cos^2 a\cos(\theta+\phi_n)} - T_n\cos\phi_n \quad (13)$$

Dimension over two pins when N is even

$$= D + d + \left[\frac{D\cos\phi_n}{\cos^2 a\cos(\theta+\phi_n)} - \frac{D}{\cos^2 a}\right] \quad (14)$$

Dimension over two pins when N is odd

$$= d + \cos\triangle\left[D + \left(\frac{D\cos\phi_n}{\cos^2 a\cos(\theta+\phi_n)} - \frac{D}{\cos^2 a}\right)\right] \quad (15)$$

British Firm to Build Largest Paper Machine

Walmsleys, Ltd., has recently secured an order to design and manufacture the largest paper making machine in the world. This machine will have a wire 320 in. in width and will produce between 200 and 235 tons of newsprint every 24 hours, that is, at the rate of 1,400 ft. per min. While a modern press can operate at the rate of about 2,000 ft. per min., few newspapers are printed at so high a speed. It is possible, therefore, to visualize the designing of a machine which would take pulp at one end and deliver it as a newspaper at the other. The first half would manufacture and calender the paper; the second would print, fold and deliver the edition.

Previous Experience Not Desired

A few years ago the college graduate had the inside track on executive jobs. The graduate of the college of hard knock didn't have a look-in. Likewise experience in the particular line involved was an essential to getting a chance at a new job. The other day a young friend of mine had a flattering offer from a well known concern to redesign an entire line of machinery and to tool up for it. The big boss told him that he was picked because he was a practical shop man with a good record, and because they had found that he *had never worked on machines in their line.* His reputation showed he knew how to tool up for production, that he had sound mechanical ideas and they wanted a man without preconceived ideas as to *what couldn't be done.* I'm strong for the college education, *plus* practical experience. But it sort of chirks me up to see the shop man given his chance.

EDITORIALS

VOLUME 78 AMERICAN MACHINIST ESTABLISHED 1877 McGRAW-HILL PUBLISHING COMPANY, INC. NUMBER 3

K. H. CONDIT F. H. COLVIN
EDITORS

Compliance

WITH THE issuance of NRA Bulletin No. 7, the Manual for the Adjustment of Complaints, the Recovery Administration undertakes the second phase of its campaign for industrial revival. The important codes are in operation, with few exceptions—and the heavy work has been done on them—and the minor codes are being handled rapidly in routine fashion. Now the job is to make them work.

The most encouraging feature of the situation is the satisfaction with operation under their codes expressed by those who have had them longest. Further refinement will undoubtedly be necessary, but the renewal of the steel and automobile codes, practically unchanged after their preliminary trial periods, is clear evidence of the workability of NRA codes.

On the other hand, the feeling that codes are not to be taken seriously, which prevails in some quarters, is most unfortunate, both for those who share it and for the codes of their respective industries. Such individuals are still complaining about price cutting competitors who are not paying the code scale. If they really know of such instances they are doing themselves, and industry as a whole, a serious injustice in not bringing the culprits up before the appropriate compliance agency.

Heretofore there may have been some excuse for hesitancy in presenting complaints. The procedure was not entirely clear because of the differing arrangements in various regions and in different industries. But this excuse is no longer valid. The new Manual states the whole procedure. In it is a flow chart to illustrate how and where complaints may originate and what their subsequent course will be. We are reproducing this chart in this number of *American Machinist* and amplifying its meaning by a compliance catechism prepared by our Washington office.

By all means study this catechism and the chart, and then act accordingly if you are aware of cases of noncompliance. Copies of the Manual may be obtained for five cents from the Superintendent of Documents at Washington or from your code authority.

American Engineering Council

IF THERE were ever a time when the engineering profession needed a responsible voice in Washington now is that time. Much of the Roosevelt relief program is based on engineering development and there is apparently no intention to slight the engineer in carrying it out. But has the engineer a voice?

Ostensibly, the American Engineering Council is that voice but the average engineer fails to realize this fact, if we may judge from the drastic cuts in funds for the Council made by the finance committees of the founder engineering societies which support it. As a matter of fact one or two of these cuts narrowly escaped being complete amputations.

What is wrong? Does the fault lie in the Council or its staff, or in the general tendency of engineers to stand aloof from civic affairs? We are inclined to distribute the blame. The engineer must overcome his aloofness. The Council must find means to inform the profession of the really excellent work that has been done, and of the many calls for help that come to it daily from the government. Its new president and secretary have a rare opportunity despite the slight financial resources at their disposal, and they deserve the full support of the engineering profession as a whole.

More Business in Government

ONE OF THE good old slogans one used to hear at meetings of chambers of commerce in the halycon days of Harding was "Less government in business, more business in government." How times have changed! Now we find some business men coming trustfully to Washington and asking the Administration to write their codes and even administer them, weakly admitting their own inability to get together and manage their own affairs. And we find Washington drafting the biggest of our business leaders, for as long as they can be held, to sit in the councils of government and help to find the way out of the depression.

The more we have of this exposure of business leaders to the machinery and problems of government the better it will be for them and for us. They will find that the politician, on the whole, is just about as honest as their competitors, if not more so. And they will discover things about themselves and their industries, as the rest of the country sees them, that will be salutary. The difficulty of keeping an important business man very long away from his own business has its compensations because it means that more such men have to be drafted to keep up the membership on the rotating boards and commissions which some genius devised.

For many months the Industrial Advisory Board has

been functioning in this fashion, to name but one example. Would it not be well to have the Code Authorities function likewise, especially as regards the Administration representatives on them? The original plan of assigning each assistant deputy administrator to sit on from ten to fifty Code Authorities does not seem workable. These men are only human after all. Why not draft leaders from other industries to represent NRA on Code Authorities of industries in which they have no stake? This arrangement would bring much more business into government and would also be highly stimulating to inter-industry cooperation.

.CHIPS.

Washington—President Roosevelt announces his monetary policy, asks for Congressional approval, and gets it . . . Amends regulations of Economy Act affecting 228,000 veterans . . . Signs bill extending life of R.F.C. to February, 1935 . . . Congress passes liquor tax law, votes guaranty of Farm Loan bond principal and interest, prepares to pass bill building Navy up to full treaty strength . . . Hopkins announces step-by-step abandonment of CWA projects and arouses storm of protest . . . Begins investigation of graft within his organization while Department of Justice goes after politicians and contractors . . . Johnson and Senator Nye agree on plan to protect small merchant and business man under NRA procedure . . . NRA issues compliance regulations as Bulletin No. 7.

Foreign—Japanese jingos try to inflame public opinion against U.S. and U.S.S.R. . . . Hevia succeeds Grau San Martin as president of Cuba, lasts a scant two days, and is succeeded by Mendieta, whose government is recognized by U.S. and South American countries . . . Germany reduces payments on bond interest making exceptions of Dutch and Swiss holders and drawing sharp protest from Roosevelt . . . Hitler "solves" his labor problem by abolishing unions and labor rights . . . Japanese finance minister ready to devaluate yen in fight for foreign markets . . . Tokio annoyed by our failure to recognize Manchukuo government in the face of treaty infractions . . . Plans taking form to protect Austria against Nazi agression. . . . Chautemps cabinet falls as Paris mobs riot over disclosures resulting from pawnshop failure.

Finance—Plan to control dollar fluctuations between 50 and 60 cents reacts favorably on stock and commodity markets . . . Federal Reserve gold being moved to the Treasury and the Mints . . . New York bond pool dissolves, its work done . . . Morganthau calls in all gold privately held . . . Railroads report better earnings . . . National income drops 40 per cent in four years, according to Department of Commerce . . . Treasury announces new issue of one billion, half in 13½-month notes at 2½ per cent, balance 7½-month certificates at 1½ per cent, to be distributed through conventional channels, and it is heavily oversubscribed . . . Ramsay MacDonald pleads for stabilization of exchange . . . Norfolk & Western declares extra dividend of $2 . . . Stock averages get back to August level . . . General Motors 1933 earnings $1.72 as against $0.09 in 1932.

Industry—Best New York show in years encourages automboile men to step up production schedules . . . Difficulties with production problems on new front ends hold up several producers . . . New Haven gets PWA loan to buy 50 passenger cars . . . Acheson Oildag raises pay 5 per cent . . . A.F. of L. demands shorter week under NRA and strengthening of bargaining provision . . . Case against leaders of organized labor grows as musicians protest racketeering methods . . . Eastman report foresees ultimate government ownership of railroads but says it is not feasible now . . . Remington Typewriter raises wages 8 to 12½ per cent . . . NRA operation lifts steel costs 70 per cent . . . No further building loans to shipping companies until arrears are reduced, says Roper . . . Governor Lehman of New York favors job insurance . . . Electrical engineers protest to Douglas against restriction of standardization activity at Bureau of Standards . . . Akron rubber companies go on 6-day week to fill orders and raises wages 10 per cent . . . United Mine Workers approve Lewis policy of demanding share of machine savings instead of fighting machine installations . . . National Industrial Conference Board reports average wage earner in industry worked 34 hours a week in December, earned $18.58, at 54.8 cents an hour; an improvement over December, 1932.

Trade—Import quotas on wines and liquors are raised to checkmate bootleggers . . . Wholesale prices continue slow raise . . . Conference of statisticians reports more than seasonal upturn in first half of January in both trade and industry . . . Buying merchandise for spring requirements is heavy both in New York and Chicago . . . Secretary Morganthau removes three barriers to Russian trade: Embargo on lumber and pulpwood, anti-dumping provision against matches, and restrictions against Russian gold which is put on same basis as other gold . . . Wholesale commodity price index rises to 72.3.

Indicators—Steel production off slightly to 33 as automobile builders fail to order up to expectations . . . Electric power production drops seasonally but is well ahead of last year . . . Carloadings rise . . . Business Week index up to 66.5.

Machine Tool Orders Soar in December

Reaching the highest level in over two years the December index of gross orders compiled by the National Machine Tool Builders' Association rose sharply to 128.6 as compared to 82.8 for November and 35.8 for December 1932. This is almost ten times the low point reached in March and represents 74 per cent of normal operation.

Overseas sales are responsible for a good part of the increase as they represent 54 per cent of the business of the reporting companies. Government orders, which are estimated at $300,000 for the first of the month, also helped to swell the index.

Shipments with an index of 69.0 and unfilled orders at 178.3 also reached a two-year peak. The back log is sufficient to carry the industry for two and a half months at the present rate of shipments.

Machine Tool Distributors Code Authority Meets in Washington

On Tuesday, January 23, the members of the Code Authority of the machine tool distributing industry met in Washington to be sworn in and to hold their first regular meeting. These men make up the committee: George H. Cherrington, Brown & Zortman Machinery Co., Pittsburgh; Marshall Prentiss, Henry Prentiss & Co., New York; Stanley Motch, Motch & Merryweather Machinery Co., Cleveland; J. Roy Porter, Marshall & Huschart Machinery Co., Chicago; J. W. Wright, Colcord-Wright Machinery & Supply Co., St. Louis; C. E. Moore, Herberts-Moore Machinery Co., San Francisco; W. S. Dyson, Halliday Machinery Co., Seattle.

MAPI Adds to Its Executive Committee

Leo W. Grothaus, of the Allis-Chalmers Mfg. Co., and Robert M. Gaylord, president of the Ingersoll Milling Machinery Co., have recently been elected to the executive committee of the Machinery and Allied Products Institute. Mr. Grothaus is the third prominent figure in Milwaukee industrial circles to be elected to this committee. The other two are Robert E. Friend, of the Nordberg Mfg. Co., and C. S. Wagner, of Koehring Co. Mr. Gaylord's election gives Rockford two spokesmen on the MAPI board. The other is A. M. Matteson, president of the Matteson Machine Works.

Auto Engineers Hold Successful Meeting

Improved business conditions were reflected in a greatly increased attendance at the annual meeting of the Society of Automotive Engineers, in Detroit, on January 22 to 25. So varied was the program that it included practically all society activities from bus operation to the sound-proofing of airplanes.

Among the widely diversified papers presented were those on front wheel stability, steering, multi-range transmissions, torque converters, diesel engines, rotating wing aircraft, carburetors, aircraft engine research, beauty as a factor inselling cars, causes of noises from tires, mufflers, bodies and intakes, and how to eliminate them, engine design, economy, performance and wear. Independent springing was carefully presented by Maurice Olley, of Cadillac, and discussed from various angles.

Discussion of electrical equipment included a session devoted to automobile radio, headlights, signals, interior car lighting and other problems and trends. David Beecroft, Bendix Aviation Corporation, pointed out the effect of NRA on the manufacture of automobiles.

The production meeting was largely devoted to external broaching, based on an excellent paper by Joseph Geschelin of *Automotive Industries*. Another discussion included theories on depreciation. Lubrication, both of engines and chassis was thoroughly covered at a special session which included a study of extreme high pressure lubrication by O. C. Bridgeman of the Bureau of Standards.

L. Clayton Hill was toastmaster at the Annual Meeting, introducing D. G. Roos, the society's new president and Dr. H. C. Dickinson, the retiring president. Paul W. Litchfield spoke on Trends in Transportation. Presentation of the Manly medal to A. H. Roy Fedden, of the Bristol Aeroplane Co., England, and the Wright Brothers medal to E. N. Jacobs, of the National Advisory Committee for Aeronautics, concluded the annual meeting.

Interesting displays of motors and automobile parts formed an attractive addition to the session. Among these were cast crankshafts of various types, lubricating devices, bearings, steering mechanisms, and these were contrasted with similar exhibits of a decade ago.

• INDUSTRIAL REVIEW •

• On the whole January was an encouraging month for the machinery trade. Inquiries were universally stronger and in some districts orders were good. Several machine tool builders report more business in January than in any month of 1933. Foreign orders continue to play an important part in the business drama; in December they made up over half of the machine tool business booked. Domestic sales ahead of November.

• New York, Philadelphia and Boston, centers of the eastern distributing district, report a strong finish for January after a slow start. An encouraging factor is that very few of the orders received came from Government sources. Inquiries are active. Pittsburgh, on the other hand, has seen a dull month. Inquiries are fairly good but orders have been almost invisible. Cleveland is forging slowly but steadily ahead and the machinery trade anticipates a good first half, much better than 1933.

• In Detroit, machinery men are expecting real programs from the automobile plants to break soon, and are figuring on several of them now. Most of the orders placed have been for special tools. Front end production problems are holding up assembly lines in almost every plant. Chicago says that January business has been up to expectations, one agent reporting that January bookings exceeded those of the first six months of 1933.

• Cincinnati is feeling much better. The first two weeks of January were slow but the last half of the month has more than made up for this. St. Louis reports nothing unexpected in the way of business, either better or worse. Automobile plant orders have boosted business in Milwaukee and things are distinctly better there.

Code Representatives Appointed

Administration representatives to code authorities for divisions of the metal-working industry were recently made as follows: commercial refrigerating manufacturing industry, William Lawson; fishing tackle manufacturing industry, John W. Power; grinding wheel industry, A. C. Cook; rolling steel door industry, William Lawson; non-ferrous ingot metal industry, L. S. Tailer.

Members of the code authority for the oxy-acetylene industry were named as follows: C. E. Adams, R. R. Browning, Lorn Campbell, R. R. Dickson, O. E. Engler, C. O. Epperson, P. B. Francis, J. R. Gobey, L. F. Loutrel, E. L. Mills and H. B. Pearson.

Engineers Request Committee on Industrial Lubricants

A request has been made by the American Society of Mechanical Engineers that a sectional committee on the classification of lubricants for industrial purposes be organized by the American Standards Association. The society offers its services as sponsor or joint sponsor for this project.

In making this proposal it was suggested that lubricants be classified for industrial use on the basis of viscosity numbers so that there will be a relatively few oils necessary.

Niles Exports Increase

Foreign shipments of machine tools of the Niles-Bement-Pond Co. for the final quarter of 1933 were double those for the entire first nine months of the year and equal to the average quarterly sales abroad during the five years 1923-28. An encouraging feature of this business is that orders were from a large number of foreign countries rather than being concentrated in a few.

Meeting of Code Authorities Called

General Johnson is calling a meeting of all the NRA code authorities—that will be about 1500 men if all come, and all code authorities are named by then—for the week of February 12 in Washington. The plan is to give a broad picture of the duties and opportunities of the code authorities, to point out the importance of solving industry problems like those of wage rates and wage scales.

Most important of all in view of the present situation will be to tell them briefly and pointedly that the anti-trust laws are not supended, except as regards certain limited matters which must be written into the codes and approved by the President, and to warn against even the shadow of suspicion of monopolistic practices which may injure the least of the small industrialists who are living up to the codes.

Metal-Working Code Hearings Scheduled

Date	Place	Deputy Administrator	Association
Feb. 1	Commerce Bldg.	H. O. King	Collapsible Tube Manufacturers
Feb. 1	Raleigh Hotel	H. O. King	American Drop Forging Institute
Feb. 2	Mayflower Hotel	H. O. King	U. S. Wood Screw Service Bureau
Feb. 2	Mayflower Hotel	H. O. King	U. S. Cap Screw Service Bureau
Feb. 2	Mayflower Hotel	H. O. King	National Galvanizers
Feb. 2	Mayflower Hotel	H. O. King	U. S. Machine Screw Service Bureau
Feb. 2	Mayflower Hotel	H. O. King	Machine Screw Nut Bureau (modification)
Feb. 6	Willard Hotel	H. O. King	American Institute of Tack Manufactures
Feb. 6	Willard Hotel	H. O. King	Hog Ring & Ringers Manufacturers
Feb. 8	Commerce Bldg.	H. O. King	National Electrical Manufacturers (modification)
Feb. 8	Washington Hotel	K. J. Ammerman	Trailer Manufacturers (reconvened)
Feb. 9	Washington Hotel	K. J. Ammerman	National Commercial Body: National Association of Commercial Vehicle Body Manufacturers (reconvened)
Feb. 9	Mayflower Hotel	H. O. King	National Screw Machine Products
Feb. 9	Mayflower Hotel	H. O. King	Furnace Pipe Institute and Eastern Pipe & Elbow Manufacturers
Feb. 9	Mayflower Hotel	H. O. King	National Auger Bit & Auger Tool
Feb. 9	Washington Hotel	H. O. King	Machinery & Allied Products Institute (39 supplemental codes)

Exports of Machinery During December, 1933

	Dec., 1933	Nov., 1933	Dec., 1932
Electrical machinery and apparatus	$5,492,096	$5,552,732	$3,193,175
Power generating machinery (except automotive and electric)	480,064	446,485	300,626
Construction machinery	295,208	308,153	254,463
Power-driven, metal-working machinery	879,333	991,931	714,705
Mining, well and pumping machinery	1,466,273	2,167,565	977,455
Other metal-working machinery	119,588	119,165	123,685
Textile machinery	585,398	611,479	333,932

Exports of Metal-Working Machinery During December, 1933

	Dec., 1933	Nov., 1933	Dec., 1932
Engine lathes	$30,183	$72,452	$14,250
Turret lathes	4,849	56,838	19,710
Other lathes	21,334	21,876	75,837
Vertical boring mills and chucking machines	6,625	6,128	11,286
Thread-cutting and automatic screw machines	86,540	41,172	37,146
Knee and column type milling machines	26,112	25,734	20,241
Other milling machines	64,748	60,892	34,181
Gear-cutting machines	50,288	85,856	83,369
Vertical drilling machines	9,837	6,001	4,047
Radial drilling machines	4,440	3,708	3,164
Other drilling machines	37,926	41,062	4,143
Planers and shapers	7,996	29,419	4,896
Surface grinding machines	53,402	54,198	4,705
External grinding machines	35,741	35,106	9,154
Internal grinding machines	47,386	30,620	21,199
Tool grinding, cutter grinding and universal grinding machines	25,156	39,409	20,227
Other metal-grinding machines	14,521	17,206	9,884
Sheet and plate metal-working machines	143,346	41,640	135,556
Forging machinery	24,309	48,659	15,662
Rolling mill machinery	17,417	33,046	34,509
Foundry and molding equipment	19,344	31,964	17,402
Other power-driven metal-working machinery and parts	147,833	208,945	134,137

Other Metal-Working Machinery

Pneumatic portable tools	32,253	29,375	26,655
Other portable and hand or foot operated metal-working machines and parts	37,768	38,712	19,545
Chucks for machine tools	11,530	7,344	3,358
Machine-operated pipe and thread cutters, stocks, dies, taps and other machine-operated tools	21,432	23,773	41,553
Other metal-working machine tools	16,605	19,961	32,574

Malcolm Muir Resigns as Division Administrator

In order to devote full time to his duties as president of the McGraw-Hill Publishing Co., Malcolm Muir, Division Administrator of the N.R.A., and one of the chief aids of General Johnson has resigned from his post in Washington. Under Mr. Muir's direction nearly 100 codes, approximately one-half of all those which have been approved by the President, have been adopted by the major industries of the country. General Johnson's letter to Mr. Muir acknowledging his resignation read in part:

"I am sorry that you feel that your other duties make it impossible for you to stay, but I have long ago determined not to importune men who have made such sacrifices as you have.

"Your work has been inspiring to me and the personal affection which has grown up between us is a net gain to me with which I would not part."

W. Averell Harriman, chairman of the Executive Committee of the Illinois Central Railroad and chairman of the Aviation Corporation, has been appointed as Division Administrator, in charge of Division II, to succeed Mr. Muir. Mr. Harriman is also director of a number of other corporations including the Guaranty Trust Co. of New York, the Manhattan Co., the Union Pacific Railroad Co., and the Western Union Telegraph Co.

Commissioner Eastman Checks Rolling Stock Serviceability

A check made by the Interstate Commerce Commission, of the serviceable reserve of freight cars and locomotives, reveals that with respect to cars neither the fear of a shortage nor reliance upon railroad reports of surplus equipment are fully justified. The condition of locomotives stored in serviceable condition is less reassuring than that of cars.

Commissioner Joseph B. Eastman reports that had the anticipated increase in fall business been realized, it is probable that the supply of serviceable cars would have been fully absorbed, although apparently sufficient numerically to avert a serious shortage. Of 118,854 stored cars reported by the railroads included in the survey as fit for transportation of all commodities for which designed, inspection disclosed that only 55.5 per cent were fit for such service; that 40.1 per cent were suitable for transportation of certain commodities only and 4.1 per cent unfit for any service until given repairs estimated at $350 per car. Fifty-six per cent of all cars inspected were built prior to 1920.

Of 5,549 locomotives stored in serviceable condition, inspection of 4,162 disclosed that 3,275 or 78.7 per cent were actually ready for service, while 887 or 21.3 per cent were in need of repairs requiring three days or more and expenditure of $150 up. A substantial number are of types designed for switching and passenger service, and others have wheel arrangement and tractive power which indicate use for branch line and secondary service. The adequacy of the locomotive reserve, as reflected in the ratio of stored locomotives to the total owned, is distorted by the fact that, of the units stored "serviceable," 41.5 have tractive power less than 40,000 lb., while 62.5 per cent rate less than 50,000 lb. Locomotives built prior to 1910 constitute 41.9 per cent of the stored power inspected, while an additional 39 per cent range from 13 to 23 years of age, leaving only 19.1 per cent less than 13 years old. The survey did not include "bad order" cars and locomotives.

Courtesy the Cleveland Plain Dealer

***Watches for Long Service*—According to a Warner & Swasey custom, employees after 25 years of service are awarded gold watches. Ambrose Swasey, chairman of the board, made five such presentations this month. The recipients are E. W. Gressle, sales department; H. J. Dengler, foreman; William M. Earley, fireman; Berger Swanson, lathe operator, and Cornelius Boehnlein, elevator operator. Gressle is the youngest man ever to receive a watch.**

Keyseater Concern Reaches Eightieth Year

Located at the exact spot in Saginaw, Michigan, where it was founded in 1843 by George W. Merrill, Mitts & Merrill this year celebrates its 80th anniversary. Mr. Merrill was sole proprietor until 1873 when a partnership was formed between his son, William Merrill and S. S. Mitts. The firm was incorporated in 1904.

Present officers of the company are: M. H. Stimson, president; Otto Schupp, vice-president, R. Perry Shorts, treasurer; and Emil Tessin, secretary. William J. Winston, plant superintendent, is now serving his 51st year.

General Johnson's Approval Final for Small Industries

An executive order by President Roosevelt has authorized National Recovery Administrator Hugh S. Johnson to approve codes for industries employing 50,000 or fewer workers. Major industries normally employing in excess of this number will still have to obtain Presidential sanction before their codes become operative.

This move was made to expedite code approval.

Questions and Answers on Code Compliance

Q. What is a Code Authority?

A. An agency established under a code of fair practice (a) to direct broad industry planning and (b) to handle complaints of code violations. It is made up of from six to twelve members from the industry and one to three administration members. In case of failure by the industry to establish its own code authority, the President may appoint all members. The industry members vote, while the administration member has no vote, but has a veto power on any action by the code authority.

Q. Are code authorities provided for in NIRA?

A. Not specifically, but in seeking a means for self-government of industry in the hearing of the first code, that of the cotton textile industry, the code authority plan was hit upon, and has been included in all subsequent codes. It has the authority of NRA and the support of all legal opinion on the subject.

Q. What is the difference between "compliance" and "enforcement" of codes?

A. In NRA terminology, "compliance" has to do with the acceptance by the units of an industry of the provisions of its code, (including the presidential order putting the code into effect, the modifications ordered, and all supplements and modifications and regulations issued pursuant to NIRA). Compliance is sought by thorough fact-finding, explanation, education, persuasion, adjustment and arbitration. "Enforcement" means the legal processes, initiated by the Federal Trade Commission or the Attorney General as a result of the failure to comply with the code; it may result in the fines and imprisonment authorized under NIRA for violators of the provisions of an approved code.

Q. How do complaints regarding code violations originate, and how are they routed?

A. The accompanying chart explains this more fully than could columns of words. Complaints regarding code violations may be made by any citizen, but labor complaints are preferably initiated by an employee or a member of the industry and trade practice complaints by a member of the industry.

Q. How are complaints regarding labor handled?

A. Complaints regarding collective bargaining (made mandatory under Section 7a of NIRA) and labor disputes that threaten strikes or lockouts (and all labor questions when they reach such a stage) are routed to the National Labor Board through its eighteen Regional Labor Boards. Complaints of violations of the wages and hours provisions of codes, or regarding other employer-employee relations, as they affect individual employees or enterprises, are made through the local industrial adjustment agency, and where not settled locally go up through the compliance machinery (see chart); such labor complaints, if they arise elsewhere, are referred back to the local adjustment agencies for preliminary studies and efforts at adjustments. Labor questions, however, cannot be taken up by the code authority until it has set up either an employer-employee relations committee or an industrial relations board of the industry, this latter to handle broad labor disputes as distinguished from or in addition to "labor complaints" regarding hours and wages. Labor problems will not be passed on to the code authority unless and until the establishment of such committee or board has been certified to the local industrial adjustment agency or to the state director of compliance. In the absence of such certification, the labor issues are handled locally and in case of difficulties go direct to NRA, or to the National Labor Board.

Q. How are complaints from consumers regarding prices handled?

A. If they come to the code authority, they are transmitted at once to the administration member, irrespective of the agency that is to handle them. The administration member is charged with the duty of seeing that they are properly and promptly taken care of. Consumers price complaints may be based on price increases directly or through impairment of quality, on alleged unlawful agreements or practices such as price fixing, or on deterrents to improved processes. They do not include complaints simply of direct code violations; those go to and are handled through the code authorities.

Q. Why do the administration members of code authorities have veto power?

A. This veto is the "substitute for the anti-trust laws in this set-up," says General Johnson. These members are named by the Administrator, are answerable to him and have as their duties watching the development of the code authority with special reference to the broad welfare of the industry, the interests of consumers and employees, assistance in preparing the code authority's recommendations for changes in the code, watching out against tendencies toward monopolies or oppression of small enterprises. They are not to interfere or dictate, and specific action under their veto power may be taken only after consultation with the Administrator.

Q. Who and how many are named usually as administration members?

A. The rule is from one to three, with a tendency to have one only, with some previous experience with the industry if practicable. The deputies who have handled the codes have in many cases been named as administration members, but the tendency will be away from this as the deputy has other specific duties in connection with compliance. However, an officer of NRA is usually named, because of the value of his experience and because his payment by the government can best be handled in this way. He will be separated definitely, however, from his NRA duties if connected with the industry on whose code authority he sits. The administration member shall have, unless the code provides otherwise, a labor and a consumer advisor, nominated respectively by the Labor and Consumer Advisory Boards of NRA and appointed by the Administrator

Q. What are the duties of the deputy in connection with code compliance?

A. He is the first officer of NRA to whom questions go from code authorities; he handles those codes which went through his hands or those of his predecessor in the code-making era. He attempts conciliation, if this has failed under the code authority, makes rulings on interpretations of the code, if clear, or obtains them from higher officials in NRA if there is question, handles all problems that may reach Washington from the code authorities, is responsible, in NRA, for the statistical data from the industries, and is the continuing relation of the code authority and the industry to NRA.

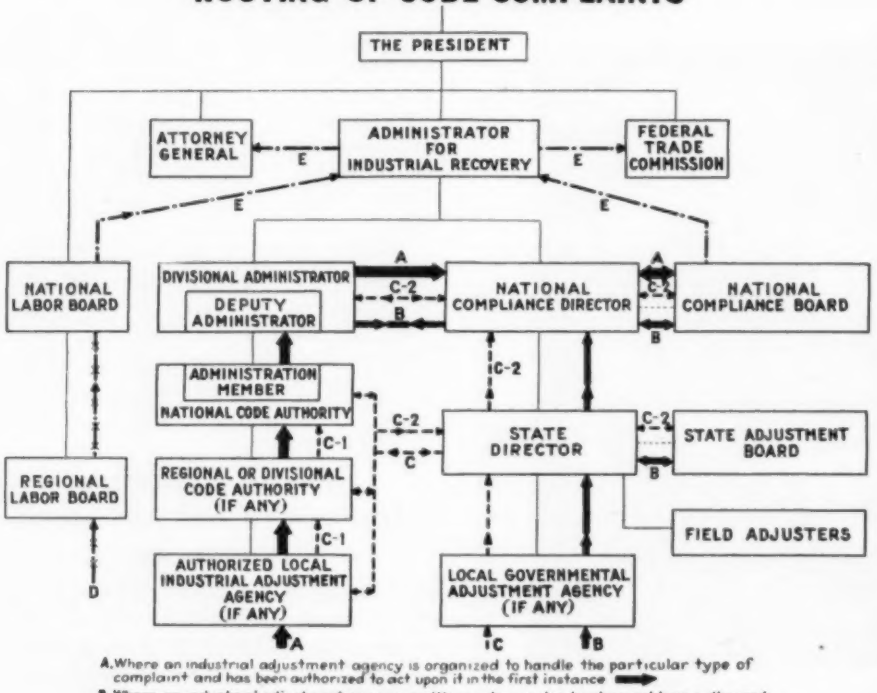
Q. What are the extent and the limitations of the powers of the NRA in code compliance and enforcement?

A. NRA is responsible, ultimately, for seeing that the codes are made effective. But the plan is for "self-government of industry" and the code authority idea has become the accepted method of this self-government. But as NRA retains the responsibility, it cannot turn over its duties to the code authority until convinced that that body is functioning, and is properly organized for its work. Therefore, NRA must certify to the qualifications of the code authorities as the code administrative agency, and retains the right to withdraw that certification or demand readjustment and reorganization of the code authority if the administration member reports, or complaints develop the fact that the code authority is not functioning properly and effectively.

Q. What is the relation of a code authority to a trade association?

A. The code authority is an emergency agency with limited powers and functions under the authority and for the duration of NIRA. Established trade associations have the relation to the code authority provided in their codes, and unless otherwise provided for in the code, the code authority is established through or by the trade association, although the President may appoint the whole code authority if conditions in the industry make it wise. The code authority is to use all data, information, contacts, of the trade association, but the code authority must so conduct itself as not to discriminate against non-members of

ROUTING OF CODE COMPLAINTS



A. Where an industrial adjustment agency is organized to handle the particular type of complaint and has been authorized to act upon it in the first instance ➡

B. Where an industrial adjustment agency is either not organized or has not been authorized to handle the particular type of complaint ➡

C. Where an industrial adjustment agency is organized and has been authorized to handle the particular type of complaint on reference, but not in the first instance - - - ➡

C-1 Where, upon reference, the industrial adjustment agency is able to handle the complaint

C-2 Where, upon reference, an industrial adjustment agency is unable to handle the complaint

D. Labor complaints arising under section 7A, NIRA, or labor disputes where a strike or lockout exists or is threatened Any such complaint should be referred directly to the appropriate regional labor board to be settled by arbitration, mediation, or conciliation ➡➡➡

E. All unadjusted complaints referred by NRA to the enforcement agencies of the government - - - ➡

the trade association. In the model arrangement, non-members of the association may participate in the code authority and the selection of its members by signing an assent.

Q. How is the code authority to be financed?

A. This should be provided in the code but NRA holds that if the code authority sets up a proper method in its bylaws, for assessment on the basis of number of employees in an enterprise, volume of business or other factors, this will be effective. Various methods have been proposed and provided in different codes. The garment trades charge a fee for NRA labels to be sewn into the product. The administration representatives are paid by the government.

Q. How are conflicts of jurisdiction between codes to be handled?

A. These complaints or controversies are submitted to the code authorities in the industries involved with the request that they confer with the rival code authority in seeking a mutually agreeable adjustment, and to draw up code amendments to be submitted by both or all to NRA. Code authorities are held to be obligated to meet in such conferences on jurisdictional problems when requested by other code authorities. If adjustment is found impossible, NRA will handle the matter in Washington and make the decision.

Q. What is the extent of the statistical information which the code authorities or NRA can require from an industry or its component parts, and how are these going to be handled?

A. These vary according to code provisions, but the suggested minimum standards include data in two classes, one for industry analysis and orderly industrial planning, called normal code administration, and the other for compliance. The statistics are primarily for analysis and planning, the normal code administration, while compliance, as such, is based primarily on complaints, but statistical data for the resolving of such complaints may be and usually is necessary. The data needed is expected to conform in most ways to standard forms of the various federal agencies, but will be modified according to the suggestions now being worked out by the Central Statistical Board of the government. NRA will try to follow the methods used in the various industries and for the purpose of informing itself shall have access to "all pertinent records" with the understanding that all information individually identified is confidential. Where a code contains price or quota provisions, or control of production or capacity, price lists are filed and the code authority is charged with seeking uniform practices of cost and other accounting, and in case of complaints against violations of such provisions of the code, the code authority or NRA may request additional information.

Q. Where does the new state organization under the National Emergency Council fit into the NRA compliance plan?

A. The president names 48 state directors who will supersede virtually all the local boards for compliance, information and local administration for the entire recovery program; the one exception will be the PRA compliance boards, which for the four months of the extension of the PRA, will continue to handle these highly detailed local problems. The state directors will ultimately absorb the functions of the 26 divisional directors of compliance and will establish local governmental adjustment agencies, which will handle labor and local industrial complaints in the first instance, where the code authorities are not set up and officialy qualified to handle them. The state directors will also have a state adjustment board and field adjusters, the whole plan being to solve complaint problems, both on labor and on trade practices, promptly and in the region where they arise, and also to make it possible for employees who may be fearful of their jobs if they complain to the code authorities, and others who have purely local connections, to obtain an early hearing.

Q. Has any provision been made to provide for the meetings of code authorities locally?

A. The plan has always contemplated having the code authorities, like their problems, go to Washington only when they cannot adjust matters themselves. NRA will set up local offices in such cities as New York and Chicago, where trade association offices are centered, and will have the administration members of code authorities sit in those centers with the different code authorities. The deputy, as noted above, will be in Washington, and be the direct NRA contact for the codes of his industries.

Fred Feiker Secretary of Engineering Council

Frederick M. Feiker, formerly director of the Bureau of Foreign & Domestic Commerce of the Department of Commerce, has assumed his duties as executive secretary of the American Engineering Council with headquarters in Washington, D. C. Mr. Feiker succeeds Lawrence W. Wallace who has resigned to become vice-president of the

FREDERICK M. FEIKER

W. S. Lee Engineering Corporation. John F. Coleman, consulting engineer and past president of the American Society of Civil Engineers, was elected president of the council.

Heald to Exhibit Machines This Week

On February 1 and 2, the Heald Machine Co. will exhibit its line of internal grinding, boring and lapping machines at its plant in Worcester, Mass. Uses of the various types of products will be demonstrated. Among the exhibits will be a grinder said to incorporate an entirely new principle.

C. L. Bardo Heads Manufacturers' Association

At a recent election of the National Association of Manufacturers, Clinton L. Bardo, president of the New York Shipbuilding Corporation, was elected president to succeed Robert L. Lund, who becomes chairman of the board. Three new vice-presidents were chosen at the same meeting. These are George H. Houston, president of the Baldwin Locomotive Works, Charles R. Hook, president of the American Rolling Mill Co., and E. C. Heidrich, Jr., president of the Peoria Cordage Co. Henry Abbott, president of the Calculagraph Co., was made treasurer, and Noel Sargent was reelected secretary.

• BUSINESS ITEMS •

SKF Industries, Inc., has moved its general and executive offices from 40 East 34th St., New York, N. Y., to Front St. and Erie Ave., Philadelphia, Pa.

Benrus Clock Co., New York, N. Y., has leased factory space in the plant of the Waterbury (Conn.) Clock Co. and plans to transfer all equipment to Waterbury.

The plant and assets of the defunct Barnes Manufacturing Co., manufacturer of hand and power pumps and sanitary enamelware, Mansfield, Ohio, was sold at receiver's sale to Barnes, Inc., which was chartered by former officials of the concern.

The Dean Forging Co., Muncie, Ind., has been purchased by M. H. BRODERICK, industrialist there, and will continue in operation. WILBUR FULL, formerly president, will continue as manager.

The Connersville Blower Co., Inc., Connersville, Ind., has changed its name to the Roots-Connersville Blower Corp., and the management will continue as heretofore.

The Stockton Profile Gauge Corp., 165 Jackson St., Lowell, Mass., has been incorporated. The company has been manufacturing adjustable conforming gauges for about a year and a half. Officers are: WALTER B. REILLY, president, WILLIAM G. SPENCE, treasurer, and E. B. REDFIELD, JR., sales manager.

The Faultless Caster Corp., 1421 North Garvin St., Evansville, Ind., has been formed to manufacture casters and other hardware for furniture. Capitalization is $100,000 and incorporators are: BERNHARD H. NOELTING, W. H. NOELTING and L. R. HALVORSEN.

The Trube Co., 101 Park Ave., New York, N. Y., has been formed by CONRAD TRUBENBACH, long associated with the Max Ams Machine Co., to furnish engineering service and to supply can making and sheet-metal working machinery and equipment.

The Muncie Gear Works, Inc., of Muncie, Ind., has been formed to manufacture machinery, tools and novelties. The incorporators are KENNEDY A. SPURGEON, W. CHASE SPURGEON and WILEY W. SPURGEON.

Robert Gardner & Son, Ltd., Montreal, manufacturers of bakers and confectioners machinery, ceased manufacturing on January 31, 1934. JOHN T. BRAIDWOOD has leased the premises.

• PERSONALS •

FRANKLIN R. HOADLEY, vice-president of the Farrel-Birmingham Co., was elected president of the Gray Iron Founders' Society at the Jan. 11 meeting. Other officers elected were: vice-president, C. B. MAGRATH, Northwestern Foundry Co., Chicago; secretary, WALTER H. COLE, Moore Brothers Co., Elizabeth, N. J., and treasurer, R. D. PHELPS, Francis & Nygren Foundry Co., Chicago.

Mr. Hoadley became connected with

FRANKLIN R. HOADLEY

the Farrel Foundry & Machine Co., Ansonia, as a foundry apprentice in 1914. In 1919 he became foundry manager, was elected a director in 1923, and on the merger with the Birmingham Iron & Foundry Co., Derby, Conn., he became a director of the Farrel-Birmingham Co. with plants at Ansonia, Derby and Buffalo. He was made a vice-president in 1930.

A. H. CHAPIN, president and treasurer of the Moore Drop Forging Co., has retired and has been elected chairman. FRANK D. FULLER and JOHN M. COLLINS, serving as vice-presidents, have been made president and treasurer, respectively.

HARRY W. CLARK, sales manager of the Grinding Wheel Division, The Norton Co., Worcester, Mass., has been promoted to general sales manager, according to an announcement by W. LA COSTE NEILSON, vice-president in charge of sales. W. R. MOORE, director of market research, becomes sales manager. HUGH D. BUTLER, NRA district compliance director is director of market research.

J. WALLACE CARREL, vice-president and general manager, Lodge & Shipley Machine Tool Co., will celebrate on February 1, the 25th anniversary of his connection with the organization.

RICHARD H. SCOTT, president and general manager of the Reo Motor Car Co. has retired. RANSOM E. OLDS, chairman of the board, has also become chairman of the executive committee. RAY DE VLIEG, for many years works manager for several Chrysler plants, and for the past three years assistant to Mr. Scott, has been elected to the executive board and becomes works manager in full charge of factory operations.

C. S. STILWELL, sales manager of the Warner & Swasey Co., Cleveland, has been elected a member of the board of directors.

JOSEPH P. BALDEZ, direct salesman for Cincinnati Milling Machine Co. and Cincinnati Grinders, Inc., has been transferred from the Cincinnati territory to the Chicago office.

M. E. TEAGUE has been made manager of the Toledo office of J. W. Mull, Jr., manufacturers' representative for production tools at Indianapolis, Ind. Mr. Teague was formerly a machine and tool representative for the Kirby Machine & Supply Co.

• OBITUARIES •

GEORGE C. AMES, former president of the American Brake Shoe & Foundry Co., New York, who retired several years ago, died January 17 at the age of 67.

PATRICK H. BRENNAN, 69, founder and general manager of the Brennan Motor Mfg. Co., manufacturer of marine and industrial engines, Syracuse, N. Y., died January 22.

RAYMOND K. EGAN, formerly president of the Fay & Egan Co., Cincinnati, machine tool builder, died January 14.

GIUSEPPE FACCIOLI, former works engineer and associate manager of the Pittsfield, Mass., works of the General Electric Co., died January 13, four years after his retirement because of ill health.

JOHN M. HARMON, manager of Factory N., International Silver Co., Meriden, Conn., died January 14. He was 77.

CHARLES W. HOLT, founder and president of Holt Electric Motor Co., died at Wauwatosa.

DAVID KENDALL, general manager of the Alliance Machine Co., Alliance, Ohio, died at the age of 68. In 1887 he joined the Morgan Engineering Co. and became general superintendent in 1901, when he went with Alliance.

WILLIAM H. BULLOCK, president of the Standard Engine Co., New York, died Jan. 25 at the age of 41.

FRANK W. KENNEDY, vice-president and general manager of the De Laval Steam Turbine Co., Trenton, N. J., died Jan. 24 at the age of 58.

EDWIN MCEWEN, recently managing director of the H. H. Franklin Mfg. Co., Syracuse, N. Y., died January 10 at Cleveland. Other connections were with the F. B. Stearns Co., and the Winton Co., and also with Willys-Overland and Velie.

MRS. GEORGE MERRYWEATHER, widow of the late GEORGE MERRYWEATHER of Motch & Merryweather, Cleveland, Ohio, died recently after a long illness. She was well known to many of her husband's friends as a woman of unusual culture and charm.

CHARLES F. MILLER, 52, founder and president of the Syracuse Stamping Co., Syracuse, N. Y., died recently after a brief illness.

L. B. Nutting, 62, president of the Foster-Wheeler Corp., New York, manufacturer of power plant equipment, died in New York on January 12. In 1893 Mr. Nutting became associated with Henry R. Worthington, founder of the Worthington Pump & Machinery Co., and later he became president of the Power Specialty Company in New York which is merged with the Wheeler Condenser & Engineering Co.

WELLINGTON W. STICKLE, purchasing agent for the Western Electric Co. in New York City, died recently.

• MEETINGS •

AMERICAN SOCIETY FOR TESTING MATERIALS. Regional meeting—symposium on outdoor weathering of metals and metallic coatings, March 7. Wardman Park Hotel, Washington, D. C. Annual meeting, June 25-29. Chalfonte-Hadden Hall, Atlantic City, N. J. A. E. HESS, assistant secretary, 260 South Broad St., Philadelphia, Pa.

OIL BURNER SHOW. Eleventh national, March 5-9. Commercial Museum, Philadelphia, Pa. HARRY F. TAPP, executive secretary, American Oil Burner Association, 342 Madison Ave., New York, N. Y.

SPECIAL TOOL, DIE & MACHINE SHOP INSTITUTE. Annual meeting, Feb. 5, Cleveland, Ohio. ROY T. WISE, managing director, Suite 336, 7016 Euclid Ave., Cleveland, Ohio.

WELDING CONFERENCE. Third annual, Feb. 28-Mar. 1. Sponsored by department of industrial engineering, Ohio State University, Columbus, Ohio. Communicate with O. D. RICKLY, assistant professor of industrial engineering.

American Machinist
REFERENCE BOOK SHEET ©

Selection of Belting and Its Care

Direct motor drives have replaced belting in many places. But belting continues to drive the great majority of machines in use and has advantages of its own in many plants.

Belting, either flat or of the V-type, plays a very important part in power transmission, especially in plants of average and small size. Whether the belt is flat or V, the power transmitted depends on the belt speed and tension and the surface in contact. Too great tension increases bearing friction and wear, and shortens the life of the belt. Too little surface in contact with the pulley, either because of a narrow belt or too small an arc of contact, decreases the power that can be transmitted. Belts should be of ample width for the work.

With long center distances between shafts, belts approximately horizontal, and the pull on the lower side, the belts can usually be run with very little initial tension. With the slack on the upper side the contact with the pulley can be well over 180 deg. Such a drive is easy on belts and on bearings, if both pulleys are of similar diameter. Short center distances prevent belts being run slack, and great differences in pulley diameter materially reduce the amount of belt contact. Belts have the advantages of being practically silent, flexible and of absorbing shocks due to starting and stopping.

Fabric Belts

Fabric belts are used in many kinds of work, usually for small or moderate power transmission. Endless woven belts, either flat or round, find a place on high-speed grinding spindles. Small-diameter pulleys and high r.p.m. are hard on such belts even though the speed in f.p.m. is not high.

Fabric belts are usually given a chemical treatment which adds both to their frictional qualities and to their life. Some treatments do not discolor the belts, others darken them. One make of fabric belts includes a layer of practically non-stretchable cords near the outer surfaces. These cords act as a rider or outer belt and tend to maintain contact between the inner belt surface and the pulley.

V-Belts

Belts of the V-type have largely replaced the round belt, which did splendid service in many places where flat belts could not be used to advantage. As with the round belt when used in a V-groove, the V-belt gets excellent adhesion from the wedging action of the belt in the groove. This is not all gain, however, as some power is exerted in pulling the belt out of the groove.

V-belts can be run with shorter center distances than with flat belts on pulleys of different diameters. Generally speaking, however, a pulley ratio of 7 to 1 is about the maximum with usual center distances. The arc of contact on the small pulley should not be less than 120 deg.

Effect of Speed and Pulley Diameter on Power Transmitted

Horsepower transmitted by a leather belt is calculated per inch of width at a given number of feet per minute. The Graton & Knight Company uses 500 ft. per min. as a basis for transmitting 1 hp. by a good single belt, one inch wide on a 3-in. pulley. This rule holds good up to speeds of 1,000 f.p.m. Above this speed the power transmitted is reduced considerably per 1,000 f.p.m. increase. This decrease is attributed to the tendency of the belt to pull away from the pulley rim because of the centrifugal force developed in the belt.

At 1,000 f.p.m. a good single belt will transmit 2 hp. per in. of width. This rate drops gradually as the speed increases to about 5,000 f.p.m. Above 5,000 f.p.m. the drop is much more rapid. A few figures from the table show the variation.

This table indicates that from 5,000 to 6,000 f.p.m. is the highest efficient belt speed. Also that a triple thickness belt transmits only double the horsepower of a single belt.

Some other belt makers use from 600 to 700 ft. per min. in calculating horsepower. The E. F. Houghton Company uses 660 ft. for single belts and 410 ft. for double belts, with very little deductions for speed up to 5,000 f.p.m. Belt tension is also considered in calculating horsepower. Desirable belt tension per inch of width is given as: 40-50 lb. for single oak-tanned belts; 60-70 lb. for double belts, and 80-90 lb. for triple belts.

Care of Belting

Leather belting requires special care to give the best service, both as to the power transmitted and the life of the belt. New belting, of good leather, contains certain oils and greases that lubricate the fibers of the leather. They also give a surface with a high coefficient of friction which reduces slippage to a minimum. These internal lubricants work out of the pores in time and also dry out in warm places. They can be replaced by occasionally dressing or treating the belt with the proper type of oils and greases.

Belting should also be kept clean. This also means to keep the face of the pulleys free from dirt, grease, chips or lumps of belt dressing or other substances. If such things accumulate they should be scraped from both pulley and belt. In scraping the belt, however, use a dull scraper to avoid injury to the fibers.

When a belt slips, examine both the belt and the pulleys to be sure they are clean. If the belt is dry and stiff use a good dressing. But don't try to make it pull an overload by using resin or sticky belt dressings. Both substances are hard on belts and at least part of the increased power is lost by the force taken to pull the belt off the pulley.

Belt tension directly affects the life of a belt. It also affects the bearings. Belts should be wide enough to pull their load without undue tension. When the starting load is very heavy or the belt must handle an overload at times, the belt width should be increased. The

Power Transmitted by Belt Thicknesses

Speed f.p.m.	Single belt 3-in. pulley		Double belt 7-in. pulley		Triple belt 22-in. pulley	
	Actual	Theoretical	Actual	Theoretical	Actual	Theoretical
500	1		1.4		2	
1,000	2		2.8		3.9	4
2,000	3.8	4	5.4	5.6	7.5	8
3,000	5.3	6	7.5	8.4	10.6	12
4,000	6.5	8	9.2	11.2	13	16
5,000	7.2	10	10.2	14	14.4	20
6,000	7.3	12	10.4	16.8	14.6	24
7,000	6.5	14	9.2	19.6	12.9	28
7,500	5.8	15	8.2	21	11.5	30

Selection of Belting and Its Care

(Continued)

Graton & Knight Company give the allowance to be made in selecting belting for services of different kinds, in the following table:

	Service Load Factor
Cotton ginning	1.0 to 1.2
Machine tools	1.0 to 1.3
Printing	1.0 to 1.3
Metal mining	1.0 to 1.4
Coal mining	1.0 to 1.4
Laundry	1.1 to 1.2
Brick and clay	1.2 to 1.3
Flour and feed mill	1.2 to 1.3
Pump and compressors	1.2 to 1.3
Woodworking	1.2 to 1.3
Fans and blowers	1.2 to 1.4
Pulp and paper	1.2 to 1.4
Rock crushing	1.2 to 1.4
Oil field	1.2 to 1.5
Textiles	1.2 to 1.5

Use an additional 1.25 for reversing or line-start motors.

Multiply the horsepower rating of the motor by the factors given for the different kinds of work. This gives the horsepower of the belt to use. If for example, a 3-hp. motor is to drive a pump, multiply by 1.2 or 1.3 and get 3.6 or 3.9 as the horsepower that the belt must handle.

Power transmitted by belting depends on the width, thickness, speed, the arc of contact, and the diameter of the smaller pulley. Power is calculated in terms of a belt one inch wide. The use of too small pulleys injures the belt fibers because of excessive bending and also adds to the slippage. Minimum diameters for different belt thicknesses are given.

Single belts	Double belts	Triple belts
3-5 in.	7-10-13 in.	22-30 in.

Increasing the diameter of the smallest pulley from one size given to the next adds approximately 10 per cent to the power transmitted. This holds fairly well at all speeds up to 7,500 f.p.m., near enough for determining the belt required, and shows conclusively the advantages of using larger pulleys.

For overloads on cog belts of the Dayton type the makers make the following suggestions:

With starting torque or peak load not over 150 per cent of full load, increase belt capacity by 25 per cent.

From 150 to 200 per cent make the increase 40 per cent.

For all reversing applications add 25 per cent.

Textile machines usually require 40 to 50 per cent more belt capacity than usual rating.

Where line-start motors start on full voltage, add 20 per cent to normal belt capacity.

Effect of Pulley Diameter

Small pulleys require sharp bending of the belt as it curves around the rim. This disturbs the belt fibers and eventually injures the belt. It also takes power to bend the belt and tends to reduce the effective belt contact. The following extract from a table by Graton & Knight shows the effect of pulley diameter. The smallest pulleys in each case are the minimum sizes considered suitable to use.

Horsepower Transmitted Per Inch of Width

Speed f.p.m.	Single belt		Double belt			Triple belt		
1,000	2	2.2	2.8	3.2	3.4	3.9	4.4	
2,000	3.8	4.2	5.4	6	6.7	7.5	8.4	
3,000	5.3	5.9	7.5	8.5	9.4	10.6	11.8	
4,000	6.5	7.2	9.2	10.4	11.5	13	14.4	
5,000	7.2	8	10.2	11.5	12.8	14.4	16	
6,000	7.3	8.1	10.4	11.6	13	14.6	16.2	
Pulley size	3-in.	5-in.	7-in.	10-in.	13-in.	22-in.	30-in.	

A little study of this table shows the disadvantage of using small pulleys.

Belt Fastenings

The joining of belts deserves careful attention. Cemented joints have many advantages where they can be used. The cementing of the lap should be done with care and the belt put on the pulley so that the point of the lap trails.

Many use a belt lacing instead of cement and there are numerous ways of lacing a belt. The lacing should weaken the belts as little as possible, and have a minimum of extra thickness as this makes a lump in going over the pulley. Metallic belt lacings are also widely used, some of which make a hinged joint that hugs the pulley closely.

No matter what kind of joint is used it should be kept in good condition. If a cemented lap comes loose it should be repaired at once. Broken belt laces should be renewed as they are often dangerous and injure the belt itself.

Repairing Belt Joints

A loose belt lap should be re-cemented promptly with a good brand of cement. If cement will not hold it there is no use in resorting to rivets. It should be re-cemented as soon as discovered. Scrape off the old cement. Roughen the surface, especially for waterproof cement, and brush off all dust. Apply a coat of cement, rubbing it in thoroughly. Let it dry before closing the joint. Then put on a second coat and bring the surfaces together quickly before the cement starts to set. Put the joint under a moderate, uniform pressure, and let it set a half hour. Don't use too much pressure; it is as bad as too little. Ordinary cement requires but one coat and is frequently as satisfactory as the waterproof type, except for moist places.

Notes

Center distance between belted shafts should be at least 20 times the belt width.

Pulley diameters should not exceed 25 per cent of the center distance between shafts for pulleys of equal diameter.

The difference in pulley diameters should not be over 25 per cent of the large diameter for best results. Ordinary variations in diameter make little difference if reasonable center distances are used.

The surest way to find the proper belt length for any drive is actually to measure over the pulleys with a steel tape. Then deduct one-tenth of an inch per foot to give proper belt tension.

Standard belt thickness is the average of 20 tightly rolled coils of belt. The allowable variation in thickness in any one length of belt is $\frac{3}{32}$ in. from its average. Belt thickness is measured in 64ths of an inch. Single belts vary from $\frac{5}{64}$ in. to $\frac{11}{64}$ in.; doubles from $\frac{16}{64}$ to $\frac{23}{64}$ in. thick.

To calculate the length of belt in a roll measure from the end of the belt to the opposite side of the hole in the center. Multiply this distance by the number of turns and by 0.2618. The answer is the length in feet.

THE ROUND TABLE

Whither Are We Bound?

"Hello, Al. I think I'll treat myself to ham and eggs for lunch today. I'm feeling happy. Williams told me this morning that we had enough orders ahead to warrant full-time, and he authorized me to put on some more men. I told you the NRA was O.K."

"I'm glad things are picking up, Ed. The pity of it is that it could have been done without tearing down business, and without a spending orgy unequalled even by the World War debauch."

"I don't agree that business was torn down. The government shut down a lot of shaky banks to give them a chance to start being honest. Then it started codes to make you business men honest."

"It wasn't necessary. Even if it was, you can't legislate men into being honest. The real truth is that a bunch of over-educated individuals, with a Messianic complex, think they are saving the country. The operation may be successful, but God help the patient when the bills come in."

"You're all wrong, Al. Those in power came to the conclusion that it was time the common people got what was coming to them and took the bull by the horns. The government will control business, and it will look after the working man even if stockholders do not get a dividend."

"There are crooks in business, I'll admit, just as there are bedbugs in houses, but people don't usually burn down the house to get rid of them. It is much cheaper to use insect powder. The whole thing is unnecessary."

"Bosh, Al. You're sore, and you make wild statements."

"If a business man objects or criticises he is persecuted and his constitutional rights are invaded. All we have now are executive edicts."

"Well, if executive edicts give shorter hours and more pay, it's 'edicts' we want. The poor man has waited a long time to get his rights, and it looks like the time is here."

"No, Ed. The time when we are going to turn lead into gold, find an El Dorado or get our rights is always in the future. It is the background of hope. We all know that the power to make ourselves invisible, to have eternal youth, or to see into the future are impossible, and still the idea persists and always will. The greatest illusion of the modern world is that all men are equal. After the first squawk equality ceases."

"Well, Al, you'll admit that things are better, that the country at large strongly favors the Administration's moves and results count."

"You and I won't see the results, Ed. That's one of the pitiful things about it. The sins of the fathers are not paid for by the fathers. To the thinking man, the whole performance is an example of the power of psychology on a fear-ridden people, and explains perfectly the power of dictators. When people face ruin, or think they do, they demand a Messiah to save them from themselves."

"Well, Al, we're going to have governmental control, and if it gives me more comforts and more leisure, I say, 'Hail the dictator.' "

Will government supervision of industry be beneficial?

Are there any examples?

Discussion

Unions or NRA?

Labor unions are rapidly losing ground and should they continue working only on the same activities in which they are now engaged, they will continue to lose ground in the future. As a means for maintaining short hours and living wages, they are now a defunct part of our system. In but a few months, NRA has done what the unions have been fighting and striving for for years. The few loose ends that NRA has apparently left dangling are being efficiently cared for by the Labor Board.

If the unions are to continue and to hold their members, their entire plan of present operations must be changed. They should now go in for backing NRA to the utmost, carefully observing and reporting infringements of any of the codes. If the unions will now spend part of their time in seeing that the advantages they have gained are not lost and that new advantages are gained where accidents, insurance, old-age pensions, child labor, sanitary working conditions and similar problems are concerned, they will live and flourish as a most important influence in the new deal.

—WILL HERMAN,
Superintendent,
Tanenbaum Oil Company,

Uniform Accounting

For all practical intents and purposes, the application of uniform accounting can be approximated in any industry. This is the more easily attained because the U. S. Department of Internal Revenue requires exact methods for the purpose of taxation. However, uniform accounting will be easier if all will cooperate in drawing up the rules, as was done in making the present codes.

What can be accomplished by getting facts on costs through proper accounting is surprising and almost unbelievable. The high cost of producing some parts will show that some of them can be purchased at considerable saving. A knowledge of costs in the hands of intelligent management will surely prevent uncontrolled price cutting. The only excuse

for price cutting would then be to prevent a plant or department organization from being broken up, or to help carry a part of the fixed overhead charges. The accurate knowledge of costs is the compass by which real management steers the business ship.

—E. E. GAGNON,
Mechanical Superintendent,
U. S. Asbestos Division.

Uniform Accounting

Personally, I have nothing against uniform accounting, but I think there are certain things that every business man who intends to adopt that system ought to be aware of. Competition will be keener. The other fellow is going to know what you are paying for material, labor and upkeep. He will be able to cut prices by using shoddy materials and your business will suffer accordingly.

If you do not fear competition, on the principle that no one can cut under your prices without sacrificing quality, that is another story.

Uniform accounting will involve a great deal of different bookkeeping, but I think we now keep too many books, and useless ones at that. Some concerns do not want to change their methods, holding up time and money as genuine obstacles. Then uniform accounting is not for them. If you study the obtainable cost charts of other concerns to figure where you can make infinitesimal cuts, then you will like uniform accounting. —FRED BENNETT,
Superintendent,
Standard Products Company.

Not only is uniform accounting practicable in the metal-working industries, but in the near future it will be a necessity if the industry is to live and flourish because NRA is opposed to price cutting in any form that is likely to lower the consuming power of the nation and retard the slow but sure upward progress of business.

To this end I believe it is but a step before government officials entrusted with putting NRA provisions into effect will use the authority vested in them, and in doubtful cases will scrutinize the books in order to bare any violations of the code. This would be bound to result in a get-together of honest manufacturers in order that a fair and equitable price for their products might be agreed upon. For purpose of comparison, it can reasonably be assumed that a standard form of accounting will be necessary and will be evolved. If business men will come to an agreement as to what constitutes a fair margin of profit, there will be no need for NRA; it will have outlived its usefulness.

—ROBERT S. ALEXANDER.

Installing a system of uniform cost-accounting that is applicable to all metal-working plants would certainly be a welcome innovation. Observations have led me to believe that much inefficiency is caused by an inadequate knowledge of systematizing and accounting purposes and results.

The great trouble is that executives have not made a thorough investigation of the systems and have installed only such portions of them as they became familiar with by previous contact. Therefore, we have in large plants a great number of uncoordinated portions of systems and influences, and too few fundamentals. If management would be a little more wary of experimenting with the systems of pseudo executives of the transient type and would concentrate on fundamentals laid down by industrialists of the Frederick Taylor type, they could evolve a universal system of accounting. —IRA S. WILLIAMS.

Moving Again

While expansion is desirable, there is always a limit. No business, no matter how good, can continue to grow forever. Every concern reaches its peak sometime, just as sure as every beginning must end, and these facts should before building a new plant. If it is felt that the business has nearly reached its peak

and larger quarters are needed, it is time to build.

There is little to choose from between a city or a country location. While building might be cheaper and the cost of labor turnover might be lower in a country location, these advantages would be offset by increased shipping charges in the long run.

—W. J. OWENS.

Time and again Al has had to change things around to provide for greater manufacturing space. To expand into the older section of the plant will mean to get along with an out-of-date and probably unsanitary shop. While this may be cheaper for the moment, it will undoubtedly be more costly in the future. On the other hand, a modern factory that has been laid out with an eye for futures expansion, and which has been designed to meet the needs of Al's immediate requirements, such as transportation to and from the plant of materials and finished products, flow of production through the shop, and with overhead kept down to the minimum, will eventually be less expensive and much more satisfactory.

With an increase in Al's business of 150 per cent in the last two years, and with business in general on the up-grade, there is hardly any doubt about his product being able to hold its own during the next few years. Taking this into consideration, it would be advisable for Al to build a plant in the country, not too far from town. His taxes would be lower than in the city and he should have no trouble in getting labor without having to provide housing for his employees. —NILS H. LOU.

The best policy for Al to follow would be to buy more space where he now is, or to build in the outskirts of his city. Moving to an entirely new location means an upset of the whole plant.

Building a plant in the country may have the advantage of cheap land and low taxes, but power is generally dearer and transport may cost more, being out of the trade center. It would also be more difficult for prospective customers to visit the plant.

In my opinion, the most satisfactory way for Al to meet the problem would be for him to stay where he now is and to work two shifts. While this would present certain difficulties, the expense of extending the plant would be avoided, as would be the building a new one, which might prove to be a heavy load should the business contract.

—W. E. WARNER,
Hertfordshire, England.

The most critical period in the life of a small plant is when it is forced to expand beyond a predetermined growth. The cause for the rise in customers' requirements should be studied analytically to arrive at a definite conclusion as to whether it is merely a spurt, or if all indications point to a steady upward trend. If the latter, Al should build a plant of his own that will suit exactly the manufacture of his product.

As a rule, it is best to select a site on the outskirts of a large city. Land there is considerably cheaper than in the city, and a plant so located will have access to a large labor market close at hand.

If Al finds that the business at hand is just a spurt that probably will not last more than a couple of years, he might rent a building large enough for anticipated requirements and buy just enough equipment to tide him over. However, before moving or buying additional equipment, he must be certain that he has utilized his present facilities to the utmost. —HAROLD L. WYNN.

• IDEAS •
FROM PRACTICAL MEN

Attachment for Scarfing Pipe—Discussion

MATTHEW HARRIS

In an article under the title given above (*AM*—Vol. 77, page 557), A. L. Hartley describes a very ingenious attachment for scarfing pipe. But why is all the complicated and expensive mechanism necessary for doing such a simple job?

About 65 years ago, the late Robert Briggs sponsored the Briggs system of standard pipe threads. He was then superintendent of the Pascal Iron Works, and designed a very simple lathe attachment for scarfing boiler flues for welding on safe ends, and also for welding pipe into long lengths for making coils. At that time, boilers had fewer and very much larger flues than at present.

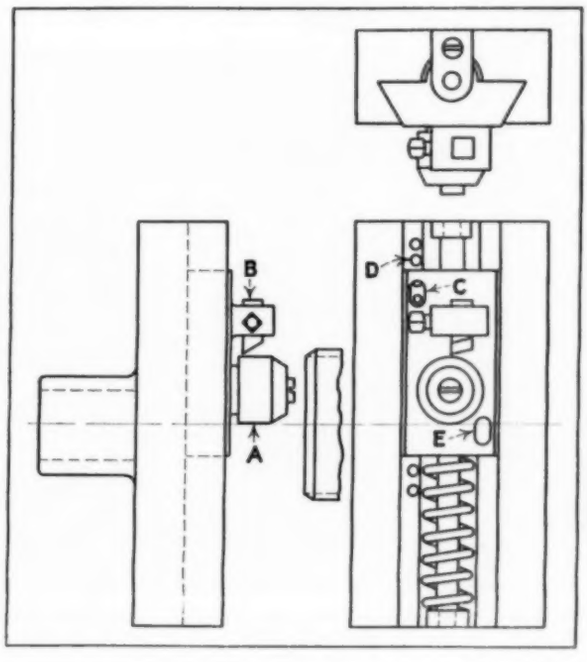
While it has been more than 30 years since I have seen the device, and may have forgotten some of the details, its essential features are embodied in the accompanying sketch. The body of the device is similar to that of a two-jaw box chuck, and the roller and the tool are both attached to the same toolblock, which is backed by a stiff helical spring. The tube, or flue, to be scarfed is clamped in a V-block mounted on the carriage in approximate alignment with the spindle, its outer end being supported on rollers at the tailstock end of the lathe. In feeding to the cut, the tube is moved endwise by the longitudinal movement of the carriage.

In starting, the toolblock is moved against pressure of the spring into a position where the tapered end of the roller *A* will enter the end of the tube. Feeding the tube endwise moves the toolblock toward the center until the straight part of the roller is in contact with the end of the tube. Continued feeding brings the end of the tube into contact with the tool *B*, cutting the scarf. After the scarf has been cut and before withdrawing the tube from the roller, a stop pin is placed through the slot *C* in the toolblock and into one of the series of holes *D* in the body, holding the toolblock so that the next tube will contact with the tapered part of the roller. By this means the toolblock does not have to be set against pressure of the spring for any but the first tube to be scarfed.

As soon as the next tube contacts with the straight part of the roller, the pin is removed. If the tube is not quite in alignment with the lathe spindle, or is out of round, the toolblock will float in its slide, so that regardless of a slight misalignment or out of roundness, the roller will be kept in contact with the inside of the tube and the scarfed end will be of uniform thickness.

For scarfing the insides of safe ends, or the opposite ends of tubes that are to be welded into long lengths, the toolblock is reversed in the body so that the roller bears on the outside of the tube and the tool cuts on the inside. The spring is also put at the opposite end of the body. The stop pin is used as before, except that it is inserted through the slot *E*, which is in line with the series of holes when the toolblock is in the reverse position. By using a smaller roller, tubes as small as 1½ in. in diameter can be scarfed.

I fail to see why this device will not do as much work and do it as well as will the more expensive attachment referred to.



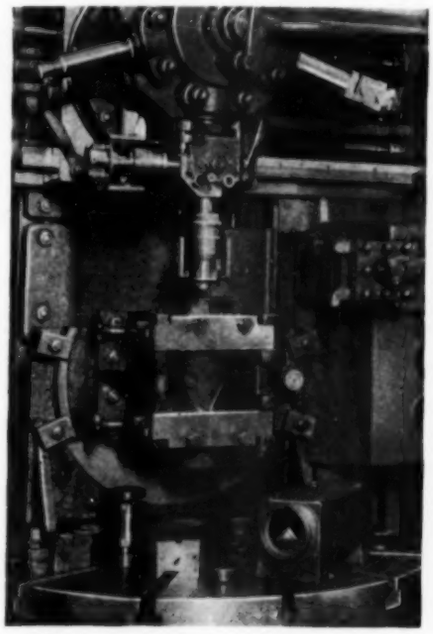
This scarfing attachment, designed by Robert Briggs, is self-aligning and may be used on both external and internal work

Two Taps Where One Grew Before

FRANK C. HUDSON

Five turret tools are enough for most jobs but the Heald Machine Company needed six on the job shown. So they made two taps grow where one grew before, by putting a double tap holder in one turret hole. The taps are at 90 deg. and either tap is held in position by the pin shown in the left hand index hole.

The indexing fixture is also of interest in showing how a machine of this type can be used on a large variety of work. This fixture enables both ends of the casting shown on the table to be machined in one set-up. It also insures



When an extra operation is needed one turret position can hold two tools

correct alignment when the fixture is accurately made, as in this case. The gages shown show that this is a production job that is held to standard tolerances.

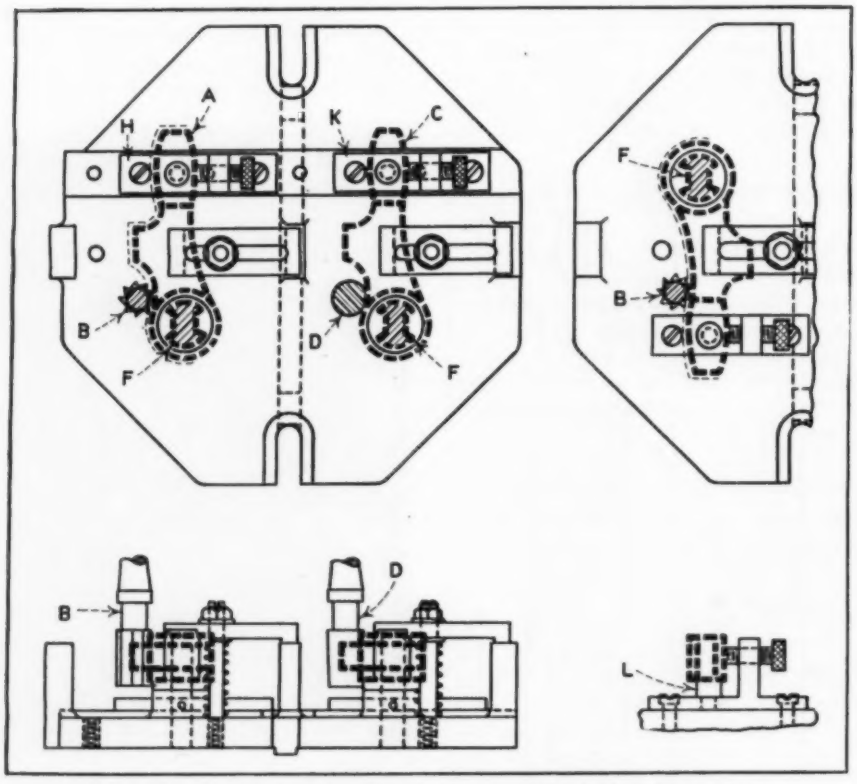
A Profiling Fixture

F. SERVER

A fixture for machining the part *A* by profiling is shown in the illustration. The part is machined in two settings by means of the cutter *B*, using a finished model of the part at *C* in connection with the former pin *D*. The two formed and shouldered studs *F* act as locating pins for both the work and the model. At *H* and *K* are holding blocks having thrust screws that are brought against both the work and the model to brace their outer ends. In addition, both the work and the model are held by clamps.

Starting with the cutter at the flat end of the work and the former pin in contact with the same end of the model, a cut is taken across the end of the work, down the left side and half-way around the boss, as indicated by the fine dotted lines in the plan view at the left. Having completed this operation on all the parts in the batch, the fixture is rotated 180 deg. in a horizontal plane and the model is transferred to what was formerly the work station, as shown in the plan view at the right, the work being put in the place vacated by the model. The holding blocks are then turned end for end and the thrust screws are brought against the work and the model on the sides opposite to which they were in contact before.

In the view in the lower right-hand corner are shown the details of one of the holding blocks and its thrust screw. The hardened pin *L* is provided to support the flat end of the work. With all parts in their new positions, the unfinished half of the boss and the curved side of the work are machined.



After the first operation has been completed the fixture is rotated a half-turn and the work and master interchanged

Squaring Large Numbers Not in the Tables
Discussion

WILLIAM C. BRUBAKER
Dean, Pullman Free School of Manual Training

I was greatly interested in the article by Samuel Kauffman under the title given above (*AM*—Vol. 77, page 759), because the method is somewhat different from anything I have seen.

The same method could be extended up to 10,000 by a very simple change in step (1), which would then read: "To the number to be squared, add a number consisting of the three right-hand digits of the original number. Multiply this sum by the fourth digit (that is the number of thousands) and add three ciphers to the right of the product."

Operation (2) will be the same as given by Mr. Kauffman, that is: "From the table, take the figures representing the smaller number and add them to the figures obtained in the first step. The sum is equal to the square of the larger number."

For example, square 4,687.

Operation (1)	
To the number.....	4,687
add the three right-hand digits.....	687
	5,374
Multiply by the fourth digit.....	4
	21,496
Add three ciphers to the right of the product.....	000
	21,496,000
Operation (2)	
Add the square of the smaller number, as taken from the table of squares.....	471,969
	21,967,969 = $4,687^2$

The following algebraic analysis may be of interest:

The number 4,687 is represented by a b, in which $a = 4{,}000$ and $b = 687$. $(a + b) = a^2 + 2ab + b^2$, which may be broken down as follows:

$a + b =$	4,687
$+ b =$	687
$a + 2b =$	5,374
$\times a =$	4,000
$a^2 + 2ab =$	21,496,000
$+ b^2 =$	471,969
$a^2 + 2ab + b^2 =$	21,967,969 = $4,687^2$

J. ERLANDSEN

The contribution by Samuel Kauffman under the title given above is a restricted use of the two following mathematical theorems:

(1) The square of the sum of two quantities is equal to the sum of their squares plus twice their product.

(2) The square of the difference of two quantities is equal to the sum of their squares minus twice their product.

Applying theorem (1) to 1,687, the number used by Mr. Kauffman, we have $1{,}687^2 = (1{,}000 + 687)^2$

$1{,}000^2$..... =	1,000,000
687^2 (as per table) =	471,969
$1{,}000 \times 687 \times 2$ =	1,374,000
	2,845,969 = $1{,}687^2$

The use of theorem (2) will produce the same result and it may often be employed advantageously to numbers, the

final digits of which are high numbers, such as, say, $14{,}983^2$

$$
\begin{aligned}
14{,}983^2 &= (15{,}000 - 17)^2 \\
15{,}000^2 &= 225{,}000{,}000 \\
17^2 &= 289 \\
& \quad 225{,}000{,}289 \\
15{,}000 \times 17 \times 2 &= 510{,}000 \\
& \quad 224{,}490{,}289 = 14{,}983^2
\end{aligned}
$$

Judgment will determine the use of the appropriate theorem.

Circular Bench for Line Assembly

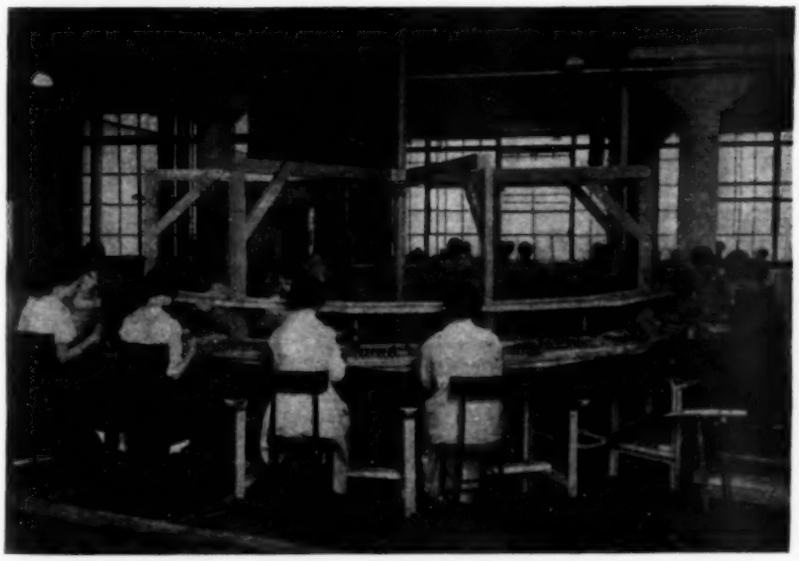
RAY HARTLEY

The ideal condition for line assembly operations is where there is always a surplus of parts and where any operator can perform any operation at any time, or all operators can perform the same operation at the same time. With the usual belt or conveyor method any parts that are not used as the conveyor passes on its way must be sorted and returned to the head end. To avoid this it is usual to limit the rate of assembly to the rate at which parts are fed to the conveyor and to confine each operator to a single operation. Inasmuch as the parts must be fed at regular intervals over the entire working period, the labor involved is at times considerable.

During the war we were given a contract for a large quantity of Mark III fuses. The size of the order and the rate of delivery was boosted so often that the additional machinery required crowded the planned assembly space almost out of existence.

As finally agreed upon, the daily output was to be 10,000 fuses per day of nine hours. An analysis of the assembly showed that there were 24 operations, some of which required three seconds to perform and others as much as twelve seconds. One or two operations required still more, but all operations were finally arranged in multiples of three seconds. The belt method was given careful consideration, but the objections above mentioned, and lack of room, ruled it out. It was finally decided to build a circular or polygonal bench about 22 ft. in diameter and to place a revolving supply table in the center. Sixteen part trays, each four feet long by 12 in. wide were made, and the parts were placed in identical locations in each tray. The rate of travel of the revolving table was adjusted so that it was always possible to pick up a part or lay down an assembly without delay. The parts were fed to the trays and the finished assemblies taken away, from the inclosed space within the table, one boy being sufficient for this purpose. The slide for ingoing material can be seen to the right.

It was not originally intended to do assembly work within the circle but it was found that certain added operations could be best performed there. Above the part trays a shelf extended around the table. Any parts that did not assemble easily for any reason were placed on this shelf and eventually came to the inspector at the end of the line. This inspector fitted the parts if possible; if not he disposed of them. This inspector can be seen near the column at the right of the illustration. The piece price for assembly, inspection and placing the packed boxes on the elevator was one cent each, and while the maximum output was figured as 10,000 per day the production frequently ran as high as 15,000 per day. Several of these tables were used for various kinds of work. The one in the illustration was driven by a back geared motor and a rope in a groove around the periphery of the table. Later ones were driven by a sprocket that engaged a link chain fastened under the revolving table.



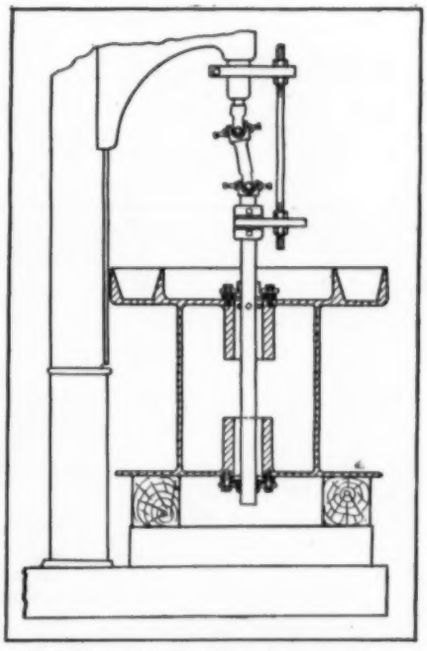
A rotating table permitted increased production in fuse assembly; workers were placed both inside and outside the circle

Increasing the Capacity of a Drill Press

FRANCIS A. WESTBROOK
Consulting Engineer

An arrangement developed by the master mechanic of a New England granite quarry is shown in the illustration. The drum of a hoisting engine was to be rebored, the flanges of which were too large in diameter to permit the work to be centered under the spindle. The boring bar was driven by the spindle through a shaft having universal joints. A bracket clamped to the quill and a fork placed between thrust collars and washers on the boring bar were connected by a rod to take care of the feed. Bushed guides for the boring bar were attached to both ends of the drum, which was carefully blocked up on the base of the machine.

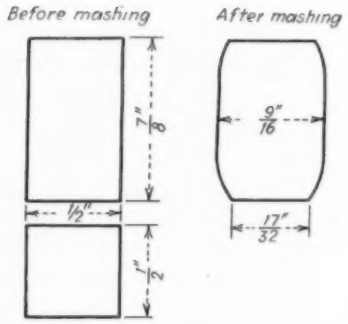
This method of boring work larger in diameter than can be centered under the spindle has been in use in this shop for some time and has been entirely successful. It has, of course, saved buying a larger drill press and it also has had the effect of greatly increasing the usefulness of the machine.



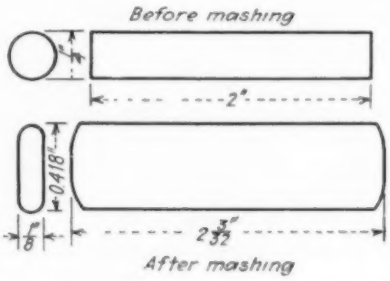
Work too large for the machine was bored by connecting the boring bar to the spindle by a shaft having universal joints

Press Work Pressures

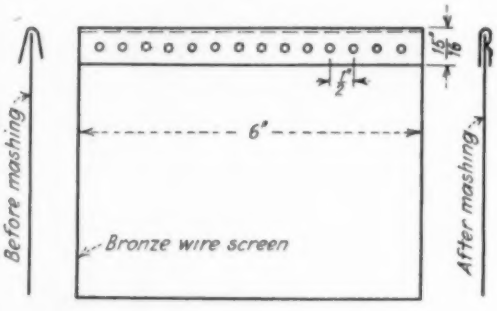
Series XXV—*Coining*



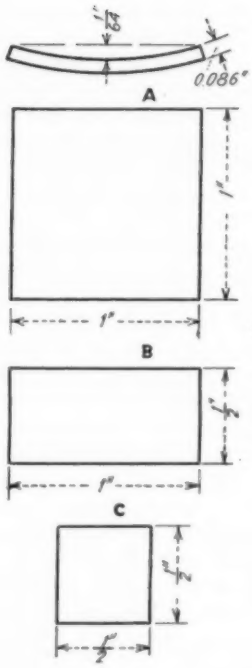
Material--A-Machine steel, 1/2 in. square by 7/8 in., before carbonizing
B-Same size piece after carbonizing Piece "B" was carbonized 14 hours in bone, then dipped in water while red hot. Depth of carbonizing - 1/32 in.
Pressure--A-Compressed 1/8 in. - 22,000 lb.
A- " 3/16 " - 26,500 "
B- " 1/8 " - 36,500 "
B- " 3/16 " - 41,500 "



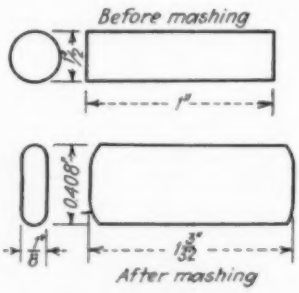
Material--Machine steel, 2 in. long by 1/4 in. in diameter
Operation--Compressed to a thickness of 1/8 in.
Pressure--84,000 lb. Not annealed



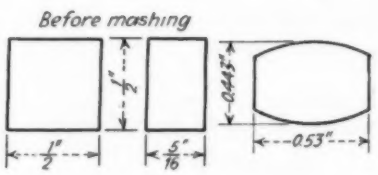
Material--Steel strip-A - 6 in. long, 0.021 in. thick
B - 5 in. long, 0.033 in. thick
Operation--Mash the steel strip on bronze wire screen
Pressure--A-1,500 lb.
B-3,500 lb.



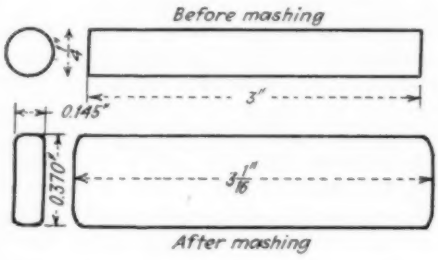
Material--0.80 carbon steel, 0.086 in. thick
Operation--Flatten between two hardened plates
Pressure--Piece A took 160 tons pressure to mash flat
Piece B took 80 tons, reduced the thickness to 0.085 in.
Piece C took 40 tons, reduced the thickness to 0.071 in.



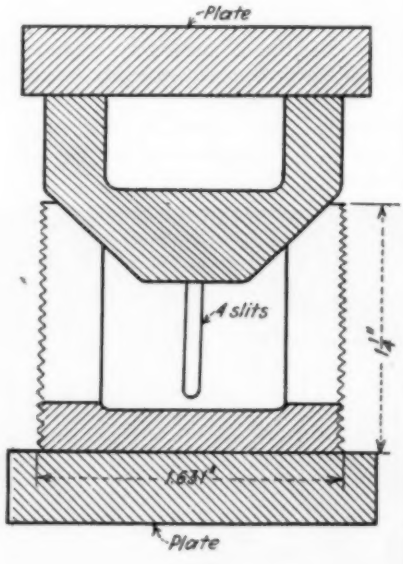
Material--Machine steel, 1 in. long by 1/4 in. in diameter
Operation--Compressed to a thickness of of 1/8 in.
Pressure--42,000 lb.



Material--Soft copper, 1/2 in. square by 5/16 in. thick
Operation--Mash to a thickness of 0.443 in.
Pressure--8,000 lb.



Material--Machine steel, 3 in. long by 1/4 in. in diameter
Operation--Compressed to a thickness of 0.145 in.
Pressure--100,000 lb. Annealed metal required about the same pressure



Material--Steel
Operation--Expanding a steam gland nut

Pressure	Expansion
300 lb.	0.002 in.
600 "	0.004 "
1,100 "	0.006 "
1,500 "	0.008 "

Contributed by C. W. LUCAS

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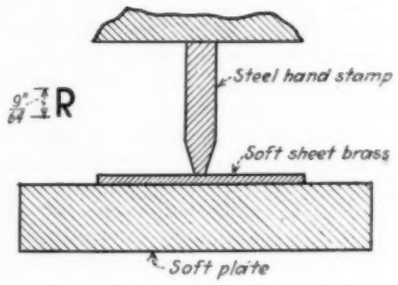
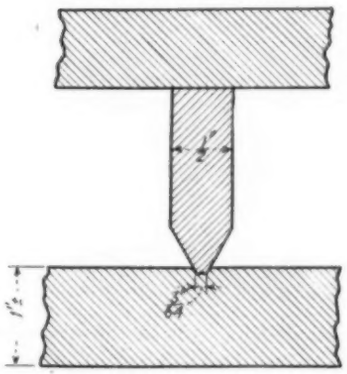
Press Work Pressures

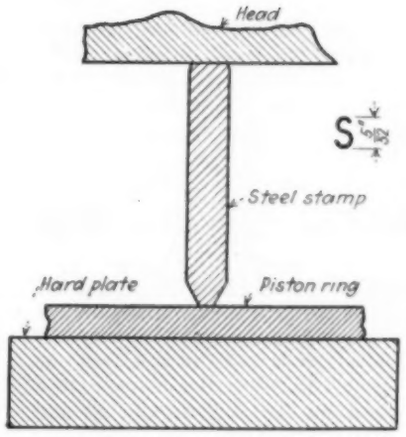
Series XXV—*Coining*



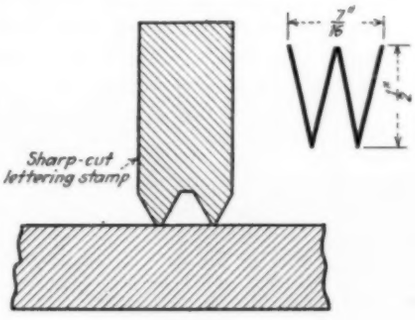
Material--A - Soft sheet brass, 0.016 in. thick
B - Soft steel, 0.016 in. thick
Operation--Stamp the letter "R" - 9/64 in. long
Pressure--A-1,000 lb.
B-1,000 lb.



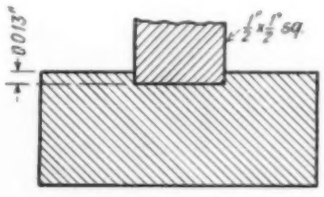
Material--Cold-rolled machine steel,
1 in. thick
Operation--Stamp a mark 1 in. long, 3/64 in. wide and of various depths
Pressure--1/64 in. deep - 18,000 lb.
1/32 " " - 24,000 "
3/64 " " - 30,000 "
1/16 " " - 36,000 "



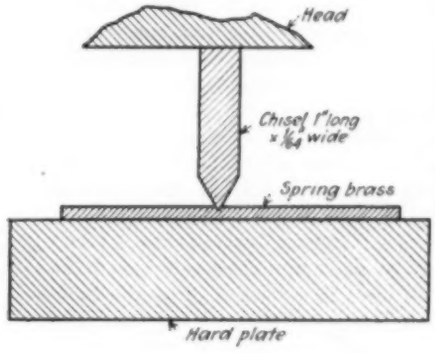
Material--Piston ring - iron casting
Operation--Stamp the letter "S" on the side
Pressure--1,400 lb.



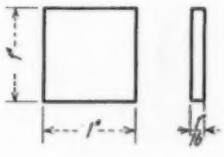
Material--A - Ordinary machine steel
B - 0.50 carbon steel
Operation--Stamp the letter "W" - 1/2 in. long and 7/16 in. wide to various depths
Pressure--A-3/128 in. deep, - 15 tons
3/64 " " - 20
1/16 " " - 25
B-1/32 in. deep - 25 tons
3/64 " " - 30
1/16 " " - 35



Material--Ordinary machine steel
Operation--Coin square depression
0.013 in. deep in the center of the piece
Pressure--20 tons

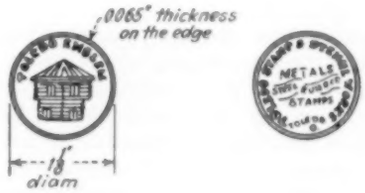


Material--Spring brass
Operation--Coin a mark 1 in. long, 1/64 in. wide and 0.010 in. deep
Pressure--1,800 lb.



Material--A- SAE 1045 steel
B- Nickel silver
Operation--Coin 1 sq. in. 1/16 in. deep
Pressure--A-108 tons
B-80 tons

Material--Soft brass, 1/16 in. thick
Operation--Stamp figures 2 or 3 to a depth of 0.010 in.
Pressure--10,000 lb.



Material--White metal, 0.065 in. thick on the edge
Operation--Coin emblem
Pressure--50 tons

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SHOP EQUIPMENT NEWS

Bullard "Hydro-Shift" Vertical Turret Lathe

Two rail heads and two side heads on the "Hydro-Shift" vertical turret lathe, developed by the Bullard Co., Bridgeport, Conn., afford complete flexibility in machining large work. Four sizes of machine are built, 56, 66, 76 and 86 in. The accompanying table gives the principal specifications. Anti-friction bearings are applied throughout the machine, except the table bearing.

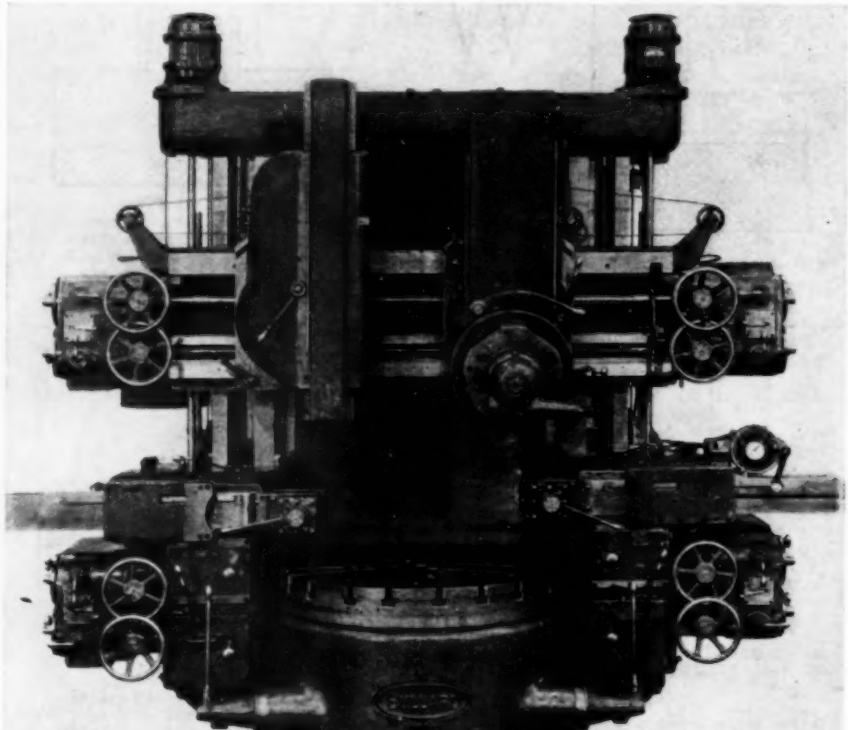
As the name "Hydro-Shift" implies, there is introduced in this machine a hydraulically operated speed shift mechanism with a visible indicator dial easily reached from the operator's station. For example, if the 56-in. machine is operating at a table speed of 3.1 r.p.m., and a higher speed is desired, the selection is made according to the dial reading without stopping operations. When ready to make the change in speed the clutch lever is moved to bring the table to a full stop and then thrown back into engaged position. In the interval, the gears are hydraulically shifted to the selected speed shown on the dial. This system eliminates the necessity for figuring the proper combination of various levers in order to obtain the desired speed, and thereby adds to the operating efficiency.

Electrification of these machines goes farther than ordinary motorization. Functions of main drive, rapid traverse and rail-raising are accomplished by means of pushbutton-controlled individual motors. Safety limit switches afford protection to the cross-rail alignment and mechanism. The rail-raising motor is operated by pushbutton control having limit switches in the circuit. Only when the four-point binders operated by the binder lever are released will the starter buttons function. When the rail is in power motion, limit switches at its safe extreme high position break the circuit and thereby stop movement. Limit switches are so placed on the side heads that regardless of the position of either one, the downward movement of the cross-rail cannot bump or strain either its own alignment or mechanism or that of the side heads.

Various attachments are available. One attachment is designed to operate from either the right-hand main head or the right-hand side head to meet the needs for thread cutting, drum scoring, or scroll cutting. A forming attachment may be affixed to the right-hand side head.

The illustration shows a 56-in. machine with two heads mounted on the cross-rail. The left-hand head is a ram type for boring, and the right-hand head is a turret type, indexed by means of a crank handle driving through a worm gear. This control prevents kick-back on the crank when heavy bars or tools over-balance the tool weight at other stations of the turret while indexing. If desired, the machine may be optionally equipped with two ram-type heads. Saddles for both types of heads are of cast iron, while both types of slides, which swivel 30 deg., are steel castings. The turrets are forged steel. The two main heads on the cross-rail are each provided with feed works and permit of rapid traverse, vertically or horizontally, each independently of the other.

The one-piece Hydro-Shift side heads are mounted directly upon the ways of the bed. The slides of each head are forged bar-steel rams provided with four-face indexing turrets. These heads have individual feed works which allow for vertical or horizontal feed of head



Bullard Hydro-Shift 56-In. Vertical Turret Lathe equipped with two rail heads and two side heads. The left-hand rail head is of the ram type for boring, and the right-hand rail head of the turret type

Specifications for "Hydro-Shift" Vertical Turret Lathe

Size	56	66	76	86
Capacity				
Diameter, in.	56	66	76	88
Under rail, in.	47	56½	62½	68½
Under turret face, in.	58½	67½	73½	79½
Floor to top of table, in.	34	34	34½	35½
Table diameter, in.	50	61	71	83
Turret Rail Head				
Vertical movement, in.	30	30	30	30
Will face, in.	56	66	76	88
Turret hole	3½	3½	3½	3½
L.H. Ram Head				
Vertical movement, in.	48	48	48	48
Will face, in.	56	66	76	88
Bar diameter, in.	4½	4½	4½	4½
Feed Changes				
Number	16	16	16	16
Maximum	0.500	0.500	0.500	0.500
Minimum	0.010	0.010	0.010	0.010
Table Speeds				
Number	16	16	16	16
With 900 r.p.m. motor minimum	3.1	2.6	2.2	1.9
With 900 r.p.m. motor maximum	74.1	60.8	52.4	44.2
With 1,200 r.p.m. motor minimum	4.2	3.4	2.9	2.5
With 1,200 r.p.m. motor maximum	99.5	80.7	69.5	58.8
With 1,200 r.p.m. motor and 17-tooth table pinion minimum	5.1	4.1	3.5	3.0
With 1,200 r.p.m. motor and 17-tooth table pinion maximum	120.0	98.0	85.0	71.5
Side Heads				
Vertical travel, in.	35½	44½	51	56½
Horizontal travel, in.	30½	30½	30½	30½
Top of table to under side of slide in high position, in.	35½	44½	51	56½
Turret size, in.	6½x6½	6½x6½	6½x6½	6½x6½
Tool size, in.	1½x2	1½x2	1½x2	1½x2
Maximum diameter side head will turn, in.	56	66	76	88
Minimum diameter side head will turn, in.	0	5½	15½	29
Traverse speed, in.	13.75	13.75	13.75	13.75
Floor space, in.	170x180	180x192	190x208	200x216
Weight				
Two main heads and two side heads, lb.	52,000	61,000	68,000	77,000

and slide, respectively, as well as vertical power traverse of the side head with horizontal power traverse of the slide. In other words, the head may be power traversed up or down while the slide is being power traversed in or out. However, it is possible to lock either head, while its slide is being fed in or out. The same is true of the slide.

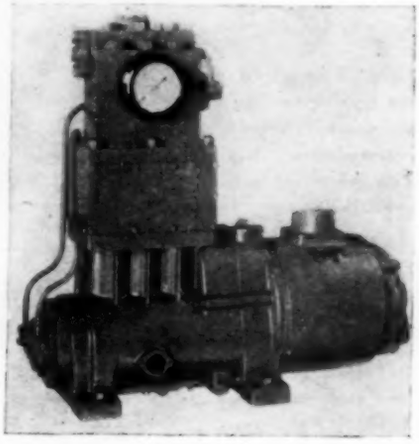
Both cross-rail heads and side heads have quick-acting, direct-reading dial controls located on the end of each feed works, permitting convenient change of feeds of any head at any time without stopping the table or other feed works. Direct-reading micrometer dials with observation stops provide a quick means for holding limits and duplicating sizes after the first setting is completed. Feed levers control the starting and direction of feeds, while trip levers on the front of the feed works provide means for stopping the feed of any desired head. Power traverse handles spring into neutral when the hand pressure is released to avoid over-running the limit. A further safety device, called an "Automatic Overload Kick-Out," covers emergency cases of feed, preventing damage from jamming due to carelessness or overload.

To enable operators to have full control of the machine from either side, clutch levers have been located at either side of the table within easy reach. These clutch levers operate the starting and stopping of the table and feeds of all heads.

Filtered oil is distributed under pressure regulated to suit various mechanisms. The ways of the rail, saddles and slides are properly lubricated, as well as the feed screws, racks, pinions and downfeed rods. Forced lubrication is delivered to the spindle bearing and all other bearings throughout the head stock and side heads. Cutting coolant systems are also provided. The 56-in. machine has a separate water pan and pump while the three larger machines require the water pan to be built into the concrete floor.

Kobe Hydraulic Triplex Power Unit

Kobe, Inc., Huntington Park, Calif., is now marketing a complete self-contained hydraulic "Triplex" power unit in 3-, 7½- and 15-hp. sizes, displacements of 1 to 12½ g.p.m., for continuous duty at pressures from 500 to 5,000 lb. per sq.in. For intermittent duty these pressures can be exceeded considerably. Because of the lightness in size, the unit can be installed as an integral part of a hydraulic machine.



The Triplex power unit is designed along the lines of a vertical automotive power plant and equipped with antifriction bearings throughout. Pump drive and motor are completely self-contained and inclosed. With the exception of a periodic crankcase oil change, no maintenance is required. Lubrication oil and the hydraulic medium are maintained separately. The plungers are of the packless type and slippage is returned to the supply. Plungers, cylinder liners, valves and valve seats are replaceable. The overall pump efficiency of the 7½-hp. unit at maximum duty is said to be 92 per cent, and with a motor efficiency of 85 per cent, the overall unit efficiency is approximately 80 per cent. The weight of the 7½-hp. unit, including the motor, is 625 lb.

"Cutanit" Titanium-Carbide Cutting Material

The American Cutting Alloys, Inc., 347 Madison Ave., New York, N. Y., is distributing their "Cutanit" titanium carbide used for cemented carbide tipped tools for cutting of metals. It is claimed to excel in the cutting of steel. It is also used for parts subject to abrasive wear such as the tips of micrometers. It is said to be resistant against oxidation and that it cuts smoothly. Because of the high strength and toughness it is claimed to stand up well under heavy and interrupted cuts.

Lincoln "Ferroweld" Electrode for Cast Iron

An electrode for welding cast iron by the shielded-arc process has been announced by the Lincoln Electric Co., Cleveland, Ohio. Known as "Ferroweld," the electrode simplifies welding procedure on cast iron and produces a weld with greater strength and ductility than the parent metal. The electrode consists of a steel core surrounded by a heavy flux coating and is manufactured in one size, ⅛ in. It is used with approximately 80 amperes of current. Welding is done intermittently, not over a 3 in. bead being laid down at one time. As each bead is welded it is peened lightly, thoroughly cleaned and allowed to cool before the next bead is deposited. Because of the low current with which it is used the hardening effect along the line of fusion is materially reduced.

Lees-Bradner Gear Tester

Both spur and helical gears can be tested on the improved gear testing machine announced by the Lees-Bradner Company, Cleveland, Ohio. This machine will check tooth contour, arc of action, length of line of action, tooth to tooth spacing, cumulative error and eccentricity. Either side of the involute curve may be checked readily, the contact point being shifted to the other side of the tooth. One attachment is supplied for testing tooth spacing and eccentricity, and another for testing tooth contour. Direct-reading indicators show plus or minus variations to 0.0001 in.

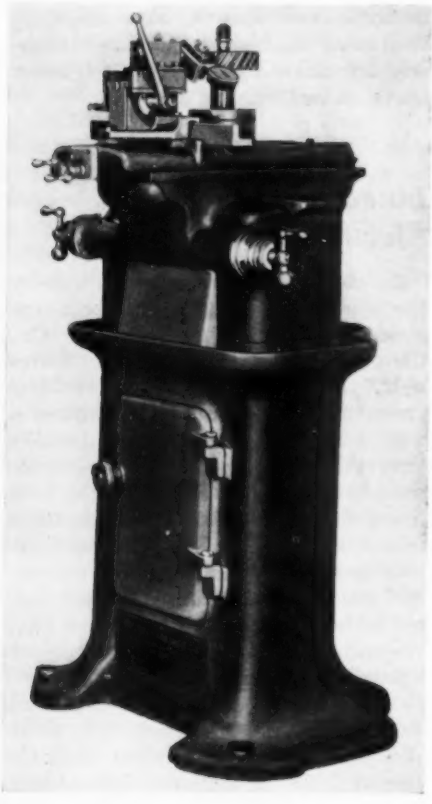
The gear tester is designed to employ the base circle of any given gear and then reproduce the tooth curve of that gear by rolling a tangent line upon the base circle and marking the path of any point in the tangent line. Provision is made for holding the straight edge in contact with the base circle under sufficient pressure to insure that it will roll upon the base circle without slippage. A contact lever is mounted with its contact surface intersecting the face of the straight edge. The straight edge is caused to roll upon the base circle and the contact lever traces the involute curve.

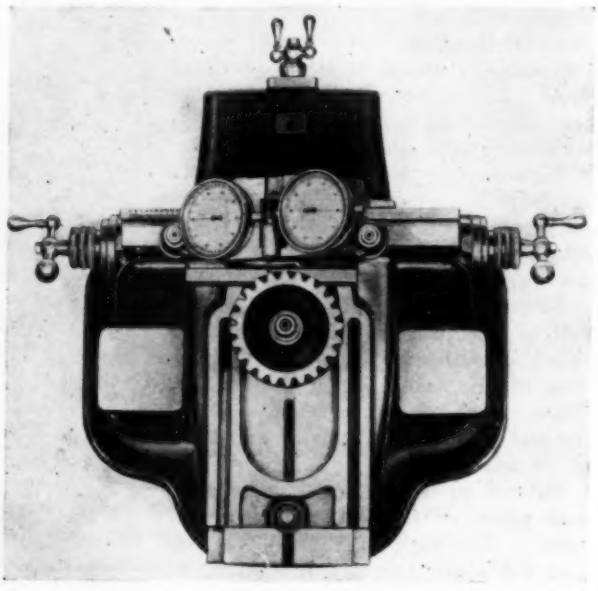
Tooth contour indicators are mounted on a tilting member and are locked in any desired position. Movement of the contact lever is always normal to the tooth. A graduation on straight-edge carrier indicates upon the graduated scale of the crossrail the distance that the straight edge has been rolled upon the base circle and thereby shows when the contact lever reaches certain successive positions on the involute curve and also measures the length of the line of action.

A gear is placed in position for testing tooth curve and the contact lever is placed to engage one tooth. The indicator is set at zero when the contactor touches the gear tooth at the base circle, or at the working depth in case this depth does not go all the way down to the base circle. The graduation on the straight-edge carrier points to zero on the scale of the crossrail when the contact lever is at the base circle, but when the teeth are not deep enough the readings start a little way from zero. The base circle is then rotated, causing the contact lever to travel up towards the point of the tooth. Graduations on the crossrail scale mark off a number of successive positions of the contact lever as it travels up from the base circle toward the tooth point, so that a record may be kept of the indicator readings. This establishes a system of measurement by means of which all gear teeth may be compared with the true involute.

Provision has been made for a simultaneous check of tooth to tooth spacing and eccentricity. The space testing device consists of a base mounted on the machine and carrying a lever-actuated slide movable radially with respect to the gear. Movement of the lever in one direction retracts the slide which is restored to its initial position by a compression spring. Located on this slide is a carrier adjustable toward and away from the gears of various pitches. Trunnioned therein is an angularly adjustable carrier locked in position by two knurled nuts and having at its axis a bore to receive the conical tooth engaging member, which may be changed for gears of different pitches and pressure angles. This trunnioned or swiveling member also carries the contactor for tooth spacing and the indicator for space errors and is adjustable to gears of 50 deg. right-hand or left-hand. All measurements are made normal to the tooth. The tooth contactor for space errors is adjustable on the small cross-slide that straddles the cone in order that it may be set for various pitches.

The entire assembly is placed in the machine and adjusted with a cone engaging the space in the gear. The eccentricity indicator on the side of the fixture reads direct in 0.0001 in. and is set to zero. Space tooth contactor is then adjusted to one side of the gear tooth and its indicator set to zero. A handle on the fixture is then pulled toward the operator, withdrawing both the cone and the contactor, and the gear is rotated through the space of one pitch, the handle is released, allowing tooth contactor to engage the gear.





Left — Lees-Bradner Gear Testing Machine set up for testing tooth to tooth spacing and eccentricity. Right — Top view of machine arranged for testing tooth curvature

Elco "Speedized" Wood Screw

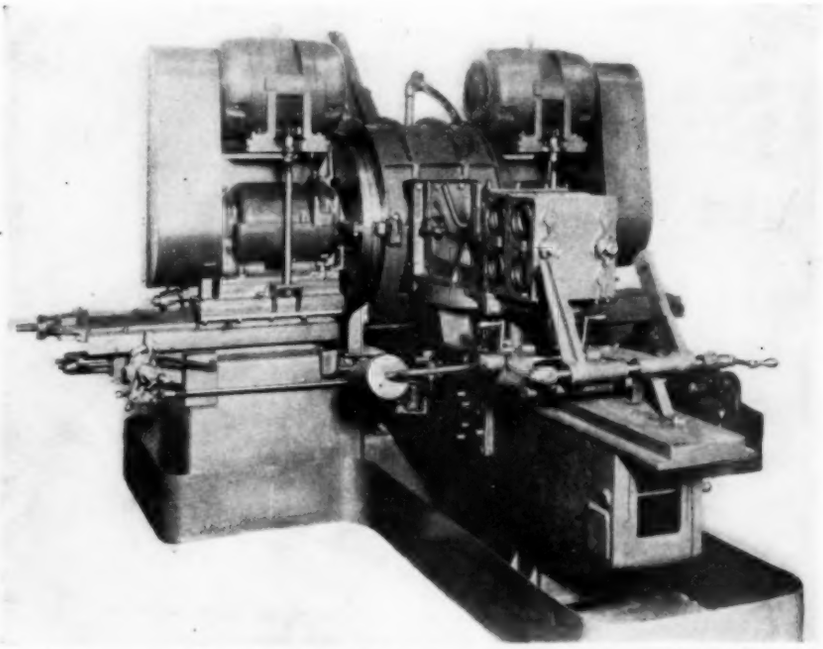
Chemically treated steel wood screws, said to require one-third the power needed to drive plain wood screws, are available in all standard sizes from the Elco Tool & Screw Corp., Rockford, Ill.

The process by which these screws are finished is called "Speedizing," for which patents are pending. So far as material and machining are concerned the "Speedized" wood screw is not distinguishable from the untreated wood screw. The company will send interested persons a small hardwood block and sample "Speedized" and plain screws for a "block" test. It is said that plain wood screws are often broken before their heads reach the upper surface of the block and considerable effort is required, while the "Speedized" screws are easily driven with the heads flush with the surface.

Gardner Coil-Spring Grinders

The Gardner Machine Co., Beloit, Wis., has developed two grinders for grinding the coil springs used in independent spring suspensions on 1934 automobiles. These springs must be ground on both ends to show parallelism and to obtain a flat seat over 75 per cent of the area of each end. It is furthermore required that the ground ends be held within one-half degree for squareness with the axis.

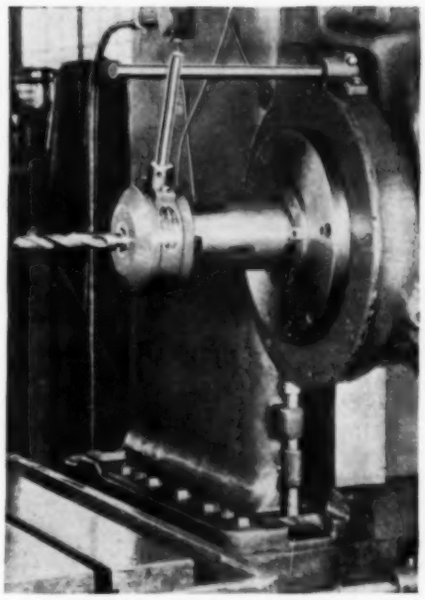
In the two grinders developed, large diameter-grinding wheels, generally 26 or 30 in., are employed. The machines are provided with an hydraulically operated oscillating knee upon which is mounted an indexing type of fixture. Each end of the fixture carries a number of springs, either 2 or 4, depending upon size and production requirements. While one end of the fixture is oscillating between the grinding members, the operator unloads and re-loads the other end. During the oscillation of the work, the two grinding wheels gradually close in upon it until the springs are ground to a pre-determined length. This infeed on the heads is not a continuous motion, but rather a few thousands with each oscillation of the work.



A representative coil spring, 12½ in. long, 5¾ in. O.D., and 11/16 in. diameter wire, is ground on a Gardner No. 84-30 in. grinder at the rate of 150 per hr. Stock removal averages 3/32 in. per end, and the springs are held within 1/32 in. for length and within 1/2 deg. for squareness with the axis

Ex-Cell-O Drill Speeder Unit

Ex-Cell-O Aircraft & Tool Corp., 1200 Oakman Blvd., Detroit, Mich., has developed a drill speeder unit for horizontal boring and milling machines, radial drills and similar machines. With this unit a higher range of speeds can be obtained for drilling the smaller sizes of holes. By its use the operator can increase the range of speeds on his machine from the minimum machine speed to 2800 r.p.m. which is the maximum speed of the unit. The ratio of the drill speeder is four to one over the spindle speed of the machine.



Ex-Cell-O Drill Speeder Unit installed on a boring mill. Head drive is furnished with a No. 5 Morse taper and the drill spindle in the nose of the drill speeder is fitted with No. 3 Morse taper to accommodate drills up to 1 1/16 in. in diameter

A boss is provided on the outside of the head in which a bar is inserted to engage with a suitable bar mounted on any stationary portion of the machine proper. The boss is furnished with the head, but both bars are provided by the customer to fit the machine. A knock-out bar for drifting the drills from the high-speed spindle projects through the driving tang so that they can be removed by means of a drift pin without removing the unit from the machine.

The units are furnished with No. 5 Morse taper drive, which enables the customer to provide suitable sleeves or adapters to fit their particular make and style of machine on which the unit is to be employed.

Electrolytic Brightening Process for Aluminum

The Aluminum Company of America, Pittsburgh, Pa., has discovered an electrolytic brightening process that increases the reflectivity of aluminum and at the same time leaves on the surface a protecting oxide film. Furthermore, a heavier protective oxide coating can be produced after the electrolytic brightening step by a second anodic process and without any substantial loss in reflectivity. The second coating is produced by means of the "Alumilite" process. As a final step the oxide coating is sealed by a special process so that stains cannot

mar the coating and its serviceability is increased. The name "Alray" has been given to reflectors made by this process.

With polished aluminum reflectors a reflection factor of 65 to 75 per cent has usually been obtained. With the electrolytic brightening process, however, a reflectivity of 87 per cent is had.

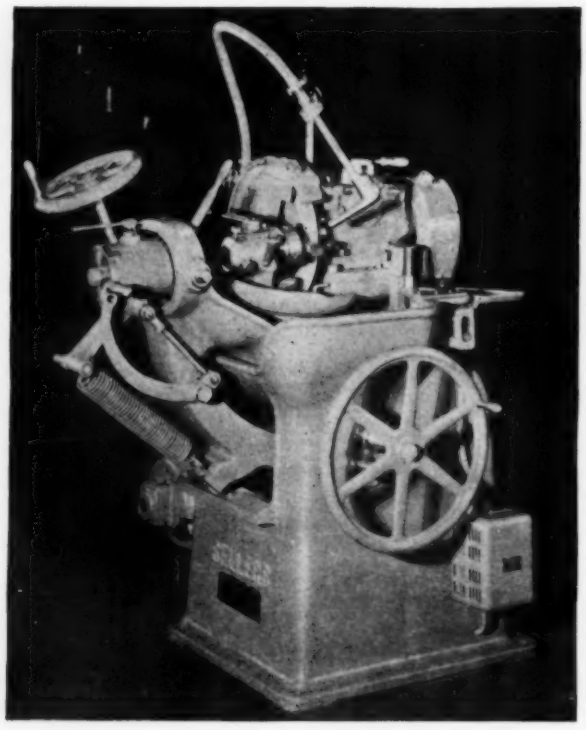
Sellers No. 2A Tool Grinder

Either cemented carbide or high-speed steel tools can be ground on the No. 2A tool grinder now being built by the William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa. The most important improvement in this machine pertains to the spindle construction. There must be no vibration or looseness of the spindle when grinding cemented carbide because of its brittleness. Consequently, a special preloaded ball-bearing mounting is now employed, instead of the plain bronze bushing used in the earlier model.

The method of driving the spindle has also been modernized. A V-belt is now used with the pulley mounted close to the bearing as contrasted with the flat belt and greatly overhung pulley formerly used. Axial oscillation of the spindle has been improved also. On the old machine this movement was obtained by an unprotected cam that caused the spindle to move back and forth in its own bearings. Now the spindle with its pre-loaded ball bearings is mounted in a large bronze sleeve which is oscillated axially by a protected cam revolving at a fixed speed and arranged with a heavy coil spring to keep the sleeve and cam in positive contact.

The whole grinding head has been designed for lubrication by a high-pressure grease gun system. Besides providing better lubrication, this method also keeps abrasive dust from working into the bearings. Backlash has been eliminated from the feed screw that actuates the in-and-out movement of the chuck. This has been accomplished by a heavy spring that insures positive contact between the nut and the screw. The wheel guard has been modified so that it can be removed by merely loosening one knurled nut. Thus, wheels can be changed quickly for grinding cemented carbide or high speed steel. The motor is now mounted on the side of the machine and has adjustment for the main drive belt tension.

Shanks up to 1½x2 in. are taken on the grinder which does all the work necessary to finish to shape from either forged or bar stock cutting tools for lathes, planers, boring mills, and which is also applicable for grinding double-end cutters for boring bars, fly cutters, inserted teeth for heavy saws, round punches, chisels, oil grooving gouges and other tools. These latter applications require special chucks or holders. The toolholder is fully universal. Drive is furnished by a 3-hp., constant-speed motor. The net weight is 2,770 lb.



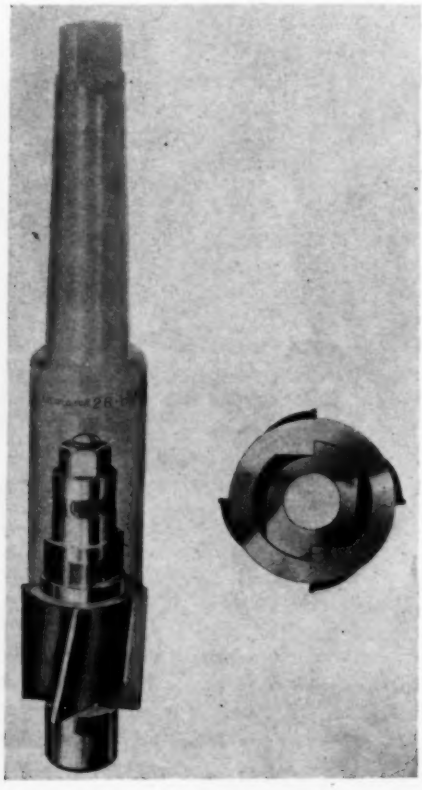
Ball - bearing spindle mounting, spindle sleeve, and quickly changed wheel adapt Sellers No. 2A Tool Grinder to grinding cemented carbides or high-speed steel

Armite High-Temperature Thread Dope

Armite Laboratories, 1900 East 65th St., Los Angeles, Calif., is marketing a metallic-lead thread lubricant for use in assembling machinery and in the repair of equipment subjected to heavy duty, high temperatures and abuse. The product is said to be finely divided metallic lead in paste form, and by its use a film of metallic lead is formed between the threads to prevent galling, to speed up repair work, and to cut costs. Pipe threads will not corrode together as the lead does not oxidize or harden. Stud bolts on the heads and exhaust manifolds of engines will not freeze. The lubricant can be used on liners and flywheels to facilitate their insertion or removal. Press work is improved by the use of the lubricant.

Eclipse Radial-Drive Counterbores

In the radial drive counterbores and other tools developed by the Eclipse Counterbore Company, 7410 St. Aubin Ave., Detroit, Mich., two radially arranged integral abutting surfaces are located between two ground cylindrical surfaces of different size. The two driving faces are arranged on a line through the common center of holder and cutter



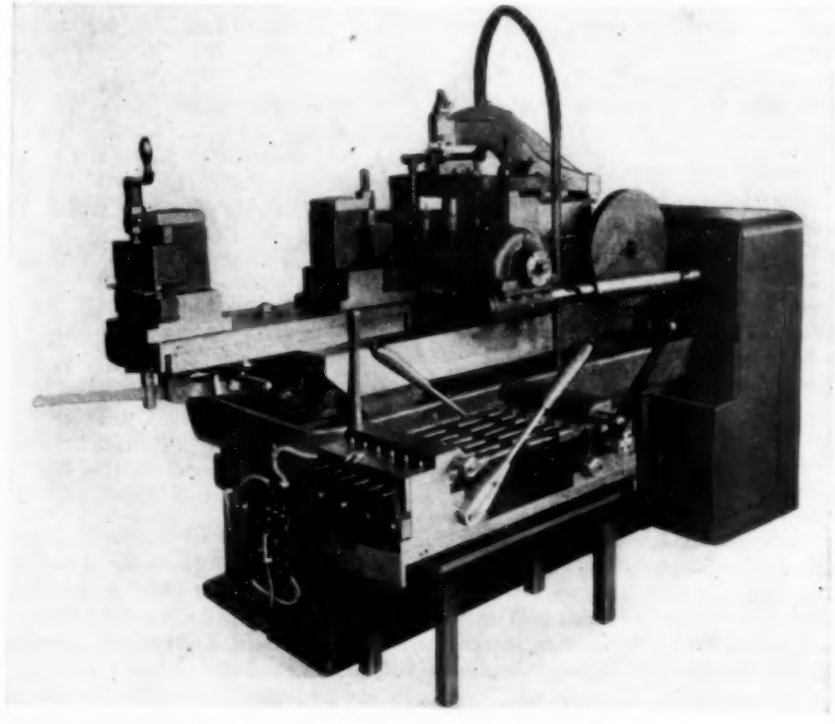
shank and only a radial or turning action results upon the tool in operation. This eliminates any wedging or splitting open of the holder. Cutter-shank driven faces are integral, being formed into the solid shank. Two ground cylindrical bearing surfaces, one above and one below the drive lugs and a ground thrust bearing, maintain concentricity of the assembled tool. The lateral internal lock retains the cutter in driving position.

Radial drive interchangeable counterbores, countersinks and multi-diameter boring cutters are supplied in all standard and special sizes from ¾ to 4½ in. in diameter. The counterbores have blades ⅛ in. longer than those of the company's pin drive counterbores, but the pilots in the latter tools are interchangeable in the radial drive tools. Larger pilot holes are provided in the cutters, size for size, and consequently stronger pilots can be used. No chips can accumulate on the holder.

Producto-Matic No. 30 Cam-Feed Milling Machine

The Producto Machine Co., Bridgeport, Conn., offers the No. 30 Producto-Matic with hand-indexed table for inexpensive and simple setups on small-quantity production. The machine takes care of "short-cut" milling operations. Cutter-slide horizontal movement is 5 in. and the vertical movement is 2 in. Thus, there can be secured a combination of movements, cam-controlled, to mill on any angle or combination of angles or radii.

The machine has a fixture base made to receive any number of interchangeable work-holding fixtures in two positions, 180 deg. apart. Fixture base indexes by hand. Clamping and locating studs are provided to register the work fixture base. The machine illustrated is equipped with two separate work-fixture bases for different types of work. One is mounted on the machine and the other is lying on the stand. At the rear is the welded-steel housing inclosing a drive for the cutters and the travel of the slide. This transmission incorporates a V-type pulley and belt, and nine changes of feeds and speeds are secured. Cutter speeds range from 42 to 600 r.p.m. and the camshaft speeds from 9 to 65 sec. per revolution. The machine requires a 3-hp. motor. Floor space is 64x32 in. Weight, with fixtures, is 6,000 lb.



"Long Arc" Method of Arc Welding Copper

Hobart Brothers Co., Troy, Ohio, has announced an economical method of welding copper by the electric arc process, and the features are said to be high strength, ductility, economy and speed. Tests have shown that by this method, using a specially developed electrode known as "Hobronz," it is possible to weld at the rate of 12 to 24 in. per min., and to obtain a strength practically 100 per cent of the strength of annealed copper. Such welds have been bent crosswise through 180 deg. without fracture. The arc welding method has been applied to brewery kettles, food processing tanks and vats, and burial vaults.

The "Long Arc" method of welding demands exceptionally high voltage across the arc. A special carbon holder must be used because the carbon gets very hot. An arc of about 1 or 1½ in. in length is conducive to the greatest strength.

• PATENTS •

OCTOBER 31, 1933

Metal-Working Machinery

Rotatable Transfer for Metal-Working Machines. William L. Clouse, Tiffin, Ohio, assigned to The National Machinery Co. Patent 1,932,396.

Control for Lathe Drives. Herman C. Klug, Tacoma, Wash. Patent 1,932,526.

Milling Machine. Benjamin P. Graves, Edgewood, and Walter A. Gigger, Providence, R. I., assigned to Brown & Sharpe Mfg. Co. Patent 1,932,546.

Duplex Hydraulic Broaching Machine. Donald H. West, Marlboro, Mass., assigned to the Lapointe Machine Tool Co. Patent 1,932,760.

Duplex Hydraulic Broaching Machine. Donald H. West, Marlboro, Mass., assigned to the Lapointe Machine Tool Co. Patent 1,932,761.

Machine for Cutting Gears and Chamfering Attachment Therefor. Maxwell H. Hill, Rochester, N. Y., asisgned to Gleason Works. Patent 1,932,781.

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Machine for Grinding Springs. Raoul Albert Herckelbout, Bagnolet, France. Patent 1,932,893.

Grinding Machine. George W. Binns, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,932,952.

Grinding Machine. Cecil W. Hopkins, Cincinnati, Ohio, and John E. Caster, Covington, Ky., assigned to Cincinnati Grinders Incorporated. Patent 1,932,969.

Milling Machine. Lester F. Nenninger and Millard Romaine, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,932,984.

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Tegarden, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,932,993.

Grinder. Clifford T. Raule, Brookline, Pa. Patent 1,933,028.

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Machine for Broaching. Harry M. Stainfield, Cleveland, Ohio. Patent 1,933,080.

Stock Feeding Mechanism for Machine Tools. Juel Leland Peterson, Seneca Falls, N. Y., assigned to Seneca Falls Machine Co. Patent 1,933,183.

Turning Machine. George F. Yager, Toledo, Ohio, assigned to The Bunting Brass & Bronze Co. Patent 1,933,201.

Metal Working Machine. George F. Yager, Toledo, Ohio, assigned to The Bunting Brass & Bronze Co. Patent 1,933,202.

Grinding Machine. Waldo J. Guild, Worcester, Mass., assigned to The Heald Machine Co. Patent 1,933,213.

Tool Slide Actuating Mechanism. Edwin R. Smith, Seneca Falls, N. Y., assigned to Seneca Falls Machine Co. Patent 1,933,224.

Work Handling Mechanism for Machine Tools. Edwin R. Smith, Seneca Falls, N. Y., assigned to Seneca Falls Machine Co. Patent 1,933,225.

Work-Handling Mechanism. Edwin R. Smith and Albert Schinkez, Seneca Falls, N. Y., assigned to Seneca Falls Machine Co. Patent 1,933,226.

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Screw Threading Machine. William Ginns Bambridge, Kettering, England, assigned to The Spiro Ball Bearing Company Ltd., Kettering, England. Patent 1,933,405.

Radial Spindle Chucking Machine. Joseph J. Spring, Berlin, Conn., assigned to The Goss & Deleeuw Machine Co. Patent 1,933,500.

Work-Rotating Structure for Machine Tools. Herbert L. Flather, Nashua, N. H. Patent 1,933,524.

November 7, 1933

Metal-Working Machinery

Milling Head Attachment. Raymond M. Woytych, Fond du Lac, Wis., assigned to Giddings & Lewis Machine Tool Co. Patent 1,933,575.

Grinding Machine. Frederick V. Geier and Frederick S. Haas, Cincinnati, Ohio, assigned to The Heald Machine Co. Patent 1,934,601.

Cam Brake for Punch Presses. William J. Buehring, Chicago, Ill., assigned to Reliable Electric Co. Patent 1,933,841.

Hob Grinder. Carl G. Olson, Chicago, Ill., assigned to Illinois Tool Works. Patent 1,933,872.

Drilling Machine. Adolph L. De Leeuw, Plainfield, N. J. Patent 1,934,044.

Die Stamping Machine. Austin H. Rankin, Rochester, N. Y. Patent 1,934,277.

Machine Tool. William F. Groene, Cincinnati, Ohio, assigned to The R. K. LeBlond Machine Tool Co. Patent 1,934,530.

Multiple Spindle Automatic Lathe. Frank L. Cone, Windsor, Vt. Patent 1,934,620.

Tools and Attachments

Gauge Mechanism for Punch Presses. George J. Greiner, New York, N. Y., assigned to Continental Can Co., Inc. Patent 1,934,303.

Automatic Turret Clamp. Oskar Kylin, Cleveland Heights, Ohio, assigned to John G. Oliver. Patent 1,934,358.

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November 14, 1933

Metal-Working Machinery

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Grinder. Henry Q. Munn, Walkerville, Ontario, Canada, assigned to DuMore Tap and Tool Co. Patent 1,935,328.

Machine for Hobbing Gear Sectors. John B. Sinderson, Rockford, Ill., assigned to Barber-Colman Co. Patent 1,935,379.

Broaching Machine. Walter Ferris, Milwaukee, Wis., assigned to The Oilgear Co. Patent 1,935,551.

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Tool Holder. Leonard A. Wellington, Keene, N. H. Patent 1,935,493.

November 21, 1933

Metal-Working Machinery

Tube Bender. John Herbert Abramson and Edwin C. Swanson, Rockford, Ill., assigned to Greenlee Bros. & Co., Patent 1,935,604.

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Gear Mechanism for Drilling Machines. Wilson P. Hunt and Henry Fink, Moline, Ill. Patent 1,935,715.

Broaching Machine for Gears. Carl J. Halborg, Detroit, Mich., assigned to Colonial Broach Co. Patent 1,935,775.

Machine Tool Organization. Edward J. Kearney, Wauwatosa, Wis., assigned to Kearney & Trecker Corp. Patent 1,935,847.

Punch Press for Forming Sheet Metal Shells. Miller A. McCreary, Danville, Ill., assigned to The Hegeler Zinc Co. Patent 1,935,854.

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Tools and Attachments

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Broach. Carl J. Halborg, Detroit, Mich., assigned to Colonial Tool Co. Patent 1,935,774.